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UNITED STATES AIR FORCE

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AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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THE EFFECT OF ECONOMIC PRICE ADJUSTMENT CLAUSES AND SELECTED PROVISIONS OF THESE CLAUSES ON THE PROFIT EARNED AND THE PROFIT RATES REALIZED ON FIXED-PRICE TYPE CONTRACTS

THESIS

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Abstract

Economic price adjustment (EPA) clauses are currently being used on Department of Defense major weapon system fixed-price type contracts to protect the contractor and the government against significant economic fluctuations in contract prices. The Armed Services Procurement Regulations provide "general guidelines" regarding the use of EPA clauses. Thus, there are many varieties of EPA clauses. They differ in the manner in which certain EPA provisions are implemented and in the methods of adjustment utilized. Little research has been conducted regarding how EPA clauses are actually being implemented and what effect these clauses have on contract cost and profit.

In this study quantitative computations were performed in order to predict the effect of EPA clauses currently in use on four fixed-price type contracts on the profit earned and the profit rates realized on these contracts. Also, the effect of varying selected provisions of the contractual EPA clauses on the profit earned and the profit rates realized on the contracts was determined. The results presented in this study should assist in determining whether changes in EPA provisions should be made in order to better support Department of Defense profit policy objectives.

THE EFFECT OF ECONOMIC PRICE ADJUSTMENT CLAUSES AND SELECTED PROVISIONS OF THESE CLAUSES ON THE PROFIT EARNED AND THE PROFIT RATES REALIZED ON FIXED-PRICE TYPE CONTRACTS

CHAPTER I

BACKGROUND

Introduction

Throughout United States history there has been a continuous interest in and controversy over Department of Defense (DOD) procedures for acquiring products and services. Much of the controversy has arisen over contractors' profits and total costs to the government. Fixed-price type contracts have been used in Department of Defense procurement in an attempt to obtain better products and to limit or reduce total costs. However, the inflation prevalent in our economy today and over the past ten years has had a detrimental effect on fixed-price type contracting. Inflation has made it more difficult to estimate total contract costs and to arrive at an equitable profit incentive. To counteract these inflationary effects, fixed-price type contracts have been augmented with economic price adjustment clauses. These clauses provide for an adjustment to contract prices for increases and decreases in the price of material and/or labor resulting from fluctuations in the economy. The purpose of this study is to determine the effects of economic price adjustment clauses and selected

provisions of these clauses on the profit earned and the profit rates realized on fixed-price type contracts.

Definitions

Several terms are fundamental to an understanding of areas addressed in this study. To insure a common basis of reference, definitions of these terms are provided below.

Inflation

Inflation means increasing prices caused by the expansion of money and credit in excess of growth in physical output and/or the increase in labor costs in excess of gains in output per manhour.

Normal and Abnormal Inflation

Normal inflation refers to that inflationary rate developed using past data which estimates a projected trend in the level of prices. Normal inflation is usually included in the contract price. Changes in price above or below this trend are termed abnormal inflation.

Economic Price Adjustment/Escalation

Economic price adjustment provides for the adjustment of contract prices for increases or decreases in general price levels. Escalation is synonymous with economic price adjustment.

Economic Price Adjustment Clause and Provisions

A contractual economic price adjustment clause stipulates the particular kind and method of adjustment that will be applied to the contract price as a result of changing price levels in the economy. Each economic price adjustment clause is made up of several provisions.

Index Number

An index number expresses the relative change in a variable (i.e., price) compared with some base figure which is normally taken as 100. (Ref 35:242). Index numbers referred to in this thesis will measure changes in the prices of labor, material, etc., between two periods. An index number covering a period of time represents the average value of the index number for the time period covered.

Standard Industrial Classification (SIC)

A system of classifying and coding establishments (i.e., an economic unit which produces goods and services) by the type of activity in which engaged. The purpose of the Standard Industrial Classification System is to facilitate collection, tabulation, presentation, and analysis of data relating to establishments; and to promote uniformity and comparability in the presentation of statistical data collected by various agencies of the government, trade associations, and private research organizations. (Ref 36:2).

Wholesale Price Index

An index which measures average price changes of all commodities and products, classified according to their use or composition.

Contingency

A contingency is the amount of money which is included in a contract price to offset any costs which the contractor might incur as a result of normal and/or abnormal inflation.

Profit

In this study profit means contract price minus contract costs. Going-in or target profit represents the profit the contractor expects to earn at the time of contract award. Coming-out or realized profit is the profit the contractor actually earns on the contract.

Profit Rate

The profit rate is the ratio of profit to total contract costs. Profit rates must be defined as going-in or coming-out rates. Coming-out profit rates are also referred to as profit rates realized.

Department of Defense Profit Policy

The Department of Defense (DOD) profit policy is set forth in the Armed Services Procurement Regulations (ASPR).

> It is the policy of the Department of Defense to utilize profit to stimulate efficient contract performance. Profit generally is the basic motive of a business enterprise. The government and defense contractors should be concerned with harnessing this motive to work for more effective and economical contract performance. . . . Effective national defense in a free enterprise economy requires that the best industrial capability be attracted to defense contracts. These capabilities will be driven away from the defense market if defense contracts are characterized by low profit opportunities. (Ref 45: 3-808.1(a)).

Thus, the intent of the DOD profit policy is to ensure that the taxpayer's money is being spent efficiently and that United States defense industrial capabilities are being sufficiently rewarded to support our national defense objectives.

Changes in the Methods Used to Support Profit Policy Objectives

In view of the DOD profit policy, the constant attention given to defense profits and to the methods used to support defense profit

policy objectives is not surprising. During the 1950's cost-plus fixed fee (CPFF) contracts were prevalent and often used in lieu of fixed-price type contracts. Between 1951 and 1961 fixed-price type contracts had declined from 58% to 47% (in terms of contract dollars) while CPFF contracts had increased from 13% to 39%. (Ref 38:117-118). With CPFF contracts, the contractor receives a specific amount of profit regardless of the costs incurred on the contract. The government (and ultimately the United States taxpayers) assumes most of the financial risk because the government reimburses the contractor for all reasonable costs incurred in the performance of the contract. Thus, during this period, contractors could make considerable profit on government contracts while assuming little financial risk. Overruns on cost-plus fixed fee contracts ranged as high as 3 to 10 times initial program estimates. (Ref 52:208). The increasing use of cost-plus fixed fee contracts and the overruns experienced on these contracts during the 1950's resulted in public accusations of allowing government contractors to profiteer at the taxpayer's expense. Of course, these accusations directly challenged DOD profit policy objectives.

In the early 1960's changes were made in the methods used to support profit policy objectives. Secretary of Defense McNamara established two principle objectives: the shift of defense procurement (1) from a noncompetitive to a competitive basis and (2) from cost-plus fixed fee contracts to firm fixed-price (FFP) and incentive contracts. (Ref 52:206-208). The Weighted Guidelines Method of determining a prenegotiation profit objective was also implemented during the early 1960's.

Competitive Procurement

Simply stated, competitive procurement requires that at least two contractors bid for a government contract. During the 1950's sole source procurement became popular due to the sophisticated nature of the weapon systems being procured. Sole source procurement made it difficult for the government to determine if the contractor's bid price was fair and reasonable, since the contract was for new effort and the government could not compare the bid price with other contractor bid prices. The shift to competitive procurement emphasized the separation of contract effort for which definitive specifications could be developed. This separation allowed for the use of competitive procurement on at least part of the original contract effort. (Ref 52:207, 208).

When competition is used, a bidder needs to consider his estimated costs and desired profit in relation to expected competing bids and the extent to which he desires the contract. Thus, competitive procurement provides contractors with an incentive to submit fair and reasonable bids in order to be awarded the contract. Furthermore, competitive procurement enables the government to compare contractor bids and to award the contract to the lowest responsive and responsible bidder.

Fixed-Price Contracts

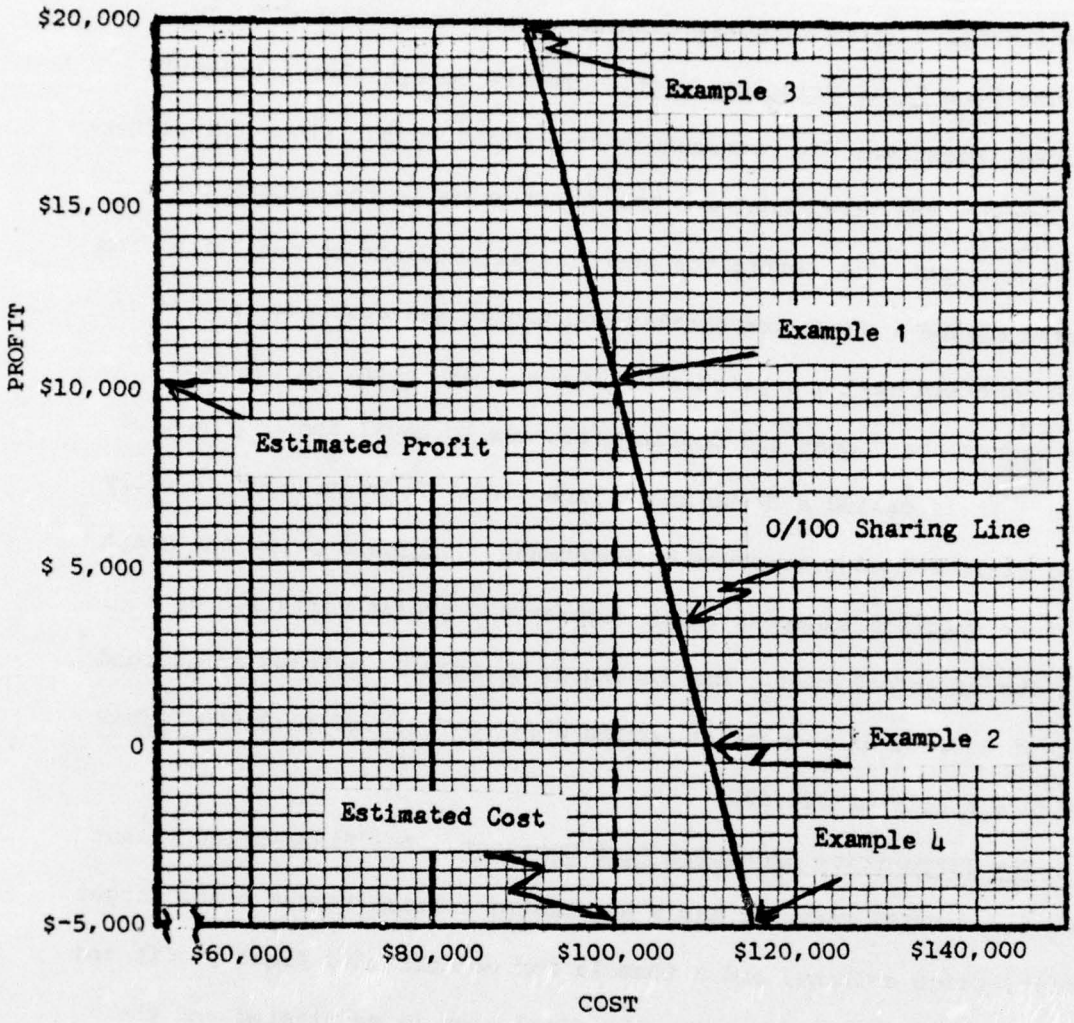
The change from cost-plus to fixed-price type contracts was made to provide a greater incentive for contractors to control costs. With fixed-price type contracts, a contractor can earn a greater amount of profit but he must do so while assuming greater financial risk. An

explanation and illustration of how the firm fixed-price and fixed-price incentive (firm targets) contracts work is presented below.

The Firm Fixed-Price Contract. The FFP contract theoretically provides incentives for contractors to control costs, since the difference between the final cost and the fixed-price is the contractor's profit or loss. The contractor receives all rewards or penalties from risks. Figure 1 shows graphically how profit and cost are related in a FFP contract having a price of $110,000. Any point on the solid line represents a cost and profit which sum to equal the contract price. It is called a 0/100 share line since the contractor is fully responsible for cost overruns or underruns. Included below the graph are four specific examples which demonstrate profit variation as a function of actual cost. For instance, example 3 includes an accrued cost of $90,000 on a contract having a fixed-price of $110,000. This yields a profit of $20,000.

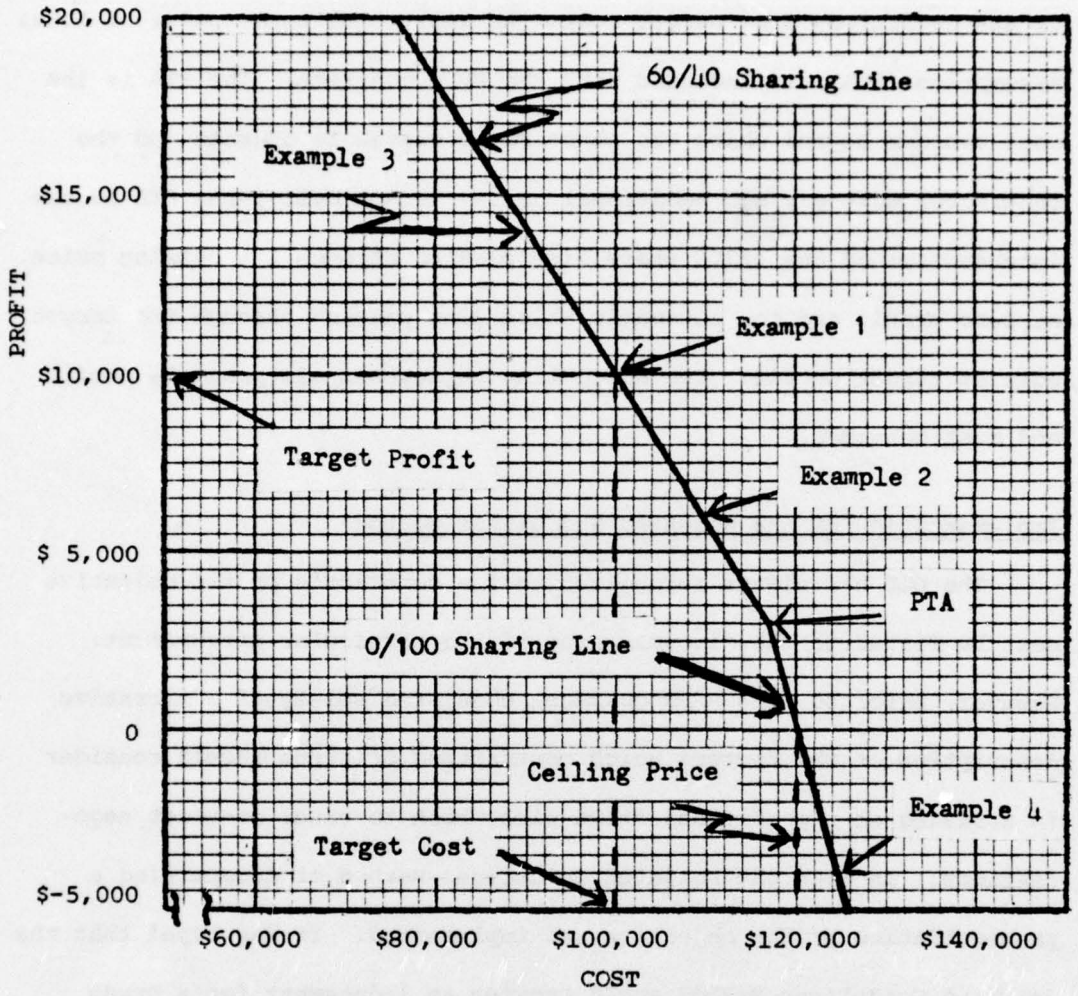
The Fixed-Price Incentive Firm Contract. The fixed-price incentive firm (FPIF) contract has a negotiated initial target cost, target profit, price ceiling, and a formula for establishing final profit and price. At contract completion the final cost is negotiated and the final price is then established in accordance with the formula. (Ref 38:81). The FPIF contract provides incentives for a contractor to perform well, because he can receive a greater profit by underrunning target costs, and can actually experience a loss on the contract due to poor performance.

Figure 2 illustrates a FPIF contract with a $100,000 target cost, $10,000 target profit, 60/40 share formula, and a ceiling price of $120,000. With a 60/40 share formula, the numerator represents the



Examples:	1	2	3	4
Contract Price	$110,000	$110,000	$110,000	$110,000
Actual Cost	100,000	110,000	90,000	115,000
Actual Profit	10,000	0	20,000	(5,000)
Actual Profit %	10.00%	0.00%	22.22%	--

Fig. 1: Fixed-Price Contract: Cost-Profit Curve for a Contract Having a Price of $110,000. (Adapted from Ref 2:20.)



Examples:	1	2	3	4
Target Price	$110,000	$110,000	$110,000	$110,000
Actual Cost	100,000	110,000	90,000	124,000
Actual Profit	10,000	6,000	14,000	(4,000)
Actual Price	110,000	116,000	104,000	120,000
Actual Profit %	10.00%	5.45%	15.56%	--

Fig. 2: Fixed-Price Incentive Firm Contract: Cost-Profit Curve for a Contract Having a 60/40 Share Ratio. (Adapted from Ref 2:25.)

customer's share and the denominator represents the contractor's share of any deviations from target cost. An additional term, point of total assumption (PTA), is included with the FPIF contract. The PTA is the cost outcome beyond which the share ratio ceases to operate and the contractor must pay all additional costs. Graphically, the PTA is the intersection of the 0/100 share line passing through the ceiling price at zero profit and the automatic share line passing through the target cost at target profit. The solid line represents all possible profit and cost outcomes.

Implementation of the Weighted Guidelines Method

The DOD has always recognized that a contract's profit objective must be fitted to the circumstances of the particular procurement. However, prior to 1964 ASPR guidance consisted solely of a narrative description of the factors which contracting officers should consider in arriving at a profit objective with which to enter contract negotiations. In 1964 the Weighted Guidelines Method of determining a prenegotiation profit objective was implemented. It was hoped that the Weighted Guidelines Method would provide an inducement for a broad reduction in defense costs by establishing a profit objective for contract negotiations which would:

1) reward the contractor who undertakes more difficult work requiring higher skills;

2) allow the contractor an opportunity to earn profits commensurate with the extent of the cost risk he is willing to assume--the greater the risk assumption the greater the profit objective established;

3) reward those contractors who have an excellent record of past performance and conversely, penalize those contractors whose performance has been poor; and

4) reward contractors who provide their own facilities and financing or who have established their competence through prior development work undertaken at their own risk. (Ref 45: Sec. 3-808.1).

The specific profit factors and their related elements which should be considered in all cases in which profit is negotiated are shown in Table I.

Under the "Contractor's Input to Total Performance," the contracting officer assigns a profit percentage within the designated weight ranges to each element of the contract costs recognized by the contracting officer. Such costs are multiplied by the specific percentage and then summed to arrive at a total dollar profit for the contractor's input to total performance factor. The total dollar profit is then divided by the total recognized costs to determine the composite profit percentage for this factor. (Ref 45: Sec. 3-808.4).

The contracting officer then adds the specific percentages assigned for cost risk, performance, other selected factors, and special profit considerations (if appropriate) to the composite percentage from the contractor's input to total performance to arrive at a total profit percentage. The prenegotiation profit objective is computed by multiplying the total recognized contract costs by the total profit percentage. The actual target profit and going-in profit rate to be included in the contract are determined during negotiations between the government and the contractor. (Ref 45: Sec. 3-808.4).

Department of Defense Profit Studies

Many studies were conducted in the 1960's and early 1970's to determine whether DOD profit policy was being achieved. The more well

TABLE I

Weighted Guidelines Profit Factors

Profit Factors	Weight Ranges
CONTRACTOR'S INPUT TO TOTAL PERFORMANCE	
Direct Materials	
Purchased Parts	1 to 4%
Subcontracted Items	1 to 5%
Other Materials	1 to 4%
Engineering Labor	9 to 15%
Engineering Overhead	6 to 9%
Manufacturing Labor	5 to 9%
Manufacturing Overhead	4 to 7%
General and Administrative Expenses	6 to 8%
CONTRACTOR'S ASSUMPTION OF CONTRACT COST RISK	0 to 7%
Type of Contract	
Reasonableness of Cost Estimate	
Difficulty of Contract Task	
RECORD OF CONTRACTOR'S PERFORMANCE	-2 to +2%
Small Business Participation	
Management	
Cost Efficiency	
Reliability of Cost Estimates	
Value Engineering Accomplishments	
Timely Deliveries	
Quality of Product	
Inventive and Developmental Contributions	
Labor Surplus Area Participation	
SELECTED FACTORS	-2 to +2%
Source of Resources	
Government or Contractor Source of Financial Material Resources	
Special Achievement	
Other	
SPECIAL PROFIT CONSIDERATION	
Development of Military Items Without Government Assistance	1 to 4%
Foreign Military Sales	1 to 4%

(Adapted from Ref 45: Sec. 3-808.4)

known and recognized studies conducted during this time period were performed by the Logistics Management Institute and the General Accounting Office.

Logistics Management Institute Studies

In November of 1967 the Logistics Management Institute (LMI) released a report on a study, conducted at the request of the DOD, concerning defense industry profits. LMI reported that:

> . . . the average profit as a percent of capital investment . . . has been lower for the past five years on . . . defense business than on . . . commercial business and also lower than the average profit included in the Federal Trade Commission and Securities and Exchange Commission (FTC-SEC) sample. (Ref 21:11).

The LMI sample for the defense and commercial profit comparisons included 23 high volume and 17 low volume companies. High volume companies had $200 million or more annual defense sales while low volume companies ranged from $25 million to $200 million in annual defense sales. The 3500 FTC-SEC companies were within the six durable goods groups which were considered to be most nearly comparable with companies in the defense industry sample. The LMI results are summarized in Table II. LMI concluded that ". . . the trend of profits on defense business of these companies since 1958 has been downward while that on their commercial business and FTC-SEC sample has been upward." (Ref 21:11).

While the trend of the percent of profit to total capital investment on defense business from 1958 through 1966 was downward, from 1958 through 1961 the percent of defense industry profit to total capital investment was higher than on either the commercial or FTC-SEC contracts. Perhaps the accusations of defense industry profiteering

during the late 1950's and early 1960's had some substance, especially in light of the DOD procurement policy of using cost type contracts in which the contractors experienced very little financial risk. However, the downward trend in defense profit from 1962 through 1966 indicated that the corrective action initiated under Secretary McNamara's guidance had taken hold.

TABLE II

Percent of Profit to Total Capital Investment (After Taxes)

Year	Defense	Commercial	FTC-SEC
1958	10.2	7.3	7.1
1959	9.5	6.8	9.3
1960	8.7	4.8	7.8
1961	7.5	4.7	7.4
1962	7.4	9.0	9.3
1963	6.5	8.7	9.8
1964	6.3	10.6	10.8
1965	7.6	11.6	12.6
1966	6.9	10.8	12.4

(Ref 21:14)

Updated Studies. In March of 1969 and 1970 LMI updated its Defense Industry Profit Review to include 1967 and 1968 profit results. For 1967 the percentage of profit on defense contracts in relation to total capital investments increased to 7.3% while commercial and FTC-SEC profits decreased to 7.4% and 10.1% respectively. However, in 1968 the percentage of profit on total investment for defense work decreased to 6.8% while commercial and FTC-SEC profits increased to 8.3% and 10.2% respectively. (Refs 22:14 and 23:11).

Summary. The LMI reports indicated a predominantly downward trend in the profitability of defense contracts from 1958 through 1968. LMI reported that its sampling had indicated that many large companies were

decreasing their defense effort and moving toward an increase in the diversification of their business. LMI concluded that the reduction in the profit rate on defense business was attributable in part to ". . . increased use of competition in DOD procurement." (Ref 22:17-19). LMI stated that there was a need for the defense department to take some kind of action to increase profitability on defense work to prevent competent firms from leaving the defense market for more attractive commercial profit opportunities. (Ref 22:24). After considering some possibilities, LMI concluded that the best hope was to modify DOD profit procedures to give greater weight to the contractor's capital investment.

Despite the LMI and other reports, critics of the defense industry continued to assert that widespread profiteering exists among defense contractors. Secretary of Defense Clifford addressed a special letter to the House and Senate Armed Services Committees on this matter. He concluded that allegations of defense profiteering were without factual basis. He explained that the 25% increase in "going-in" profits was attributable to the continued trend from lower risk cost type contracts to higher risk incentive and firm fixed-price contracts. He stated that these high risk contracts merited the higher going-in profit percentage on the theory that they resulted in lower overall cost to the government. Secretary Clifford also noted that the LMI studies did not establish a corresponding increase in "coming-out" profits. As a matter of fact, the results of these studies were to the contrary. (Ref 38:129).

The General Accounting Office Profit Study

Partially in response to the allegations of profiteering on defense contracts, the General Accounting Office (GAO) was directed

by Congress to make a study of profits on defense contracts. The GAO Defense Industry Profit Study was submitted to Congress in March 1971. The study covered over half of all defense procurements (and about 60% of awards over $10,000.00) for the four years 1966-1969 inclusive. The findings of the study are indicated below.

> Profit before Federal income taxes, on Defense work, measured as a percentage of sales, was significantly lower than on comparable commercial work for 74 large DOD contractors included in the GAO study. For example, profits on DOD contracts averaged 4.3 percent of sales over the 4 years, 1966 through 1969, but profits on comparable commercial work of the 74 contractors averaged 9.9 percent of sales for the same period. When profit was considered as a percent of the total capital investment (total liabilities and equity but exclusive of Government capital) used in generating the sales, the difference narrowed--11.2 percent for DOD sales and 14 percent for commercial sales. Further, when profit was considered as a percent of equity capital investment of stockholders, there was little difference between the rate of return for Defense work and that for commercial work. The 74 large DOD contractors realized average returns before Federal income taxes of 21.1 percent on equity capital allocated to defense sales and 22.9 percent on equity capital allocated to commercial sales. (Ref 12:15).

Thus, the GAO study found that profits on defense work were lower than on commercial work performed by the same firms on all three measures employed--significantly lower, in fact, under two of the measures.

Growing Concerns

As a result of the profit studies conducted in the 1960's and early 1970's and fluctuations in the economy during the 1970's, many Department of Defense officials have expressed a genuine concern that the Department of Defense is not utilizing profit to stimulate efficient contract performance and that meager profit returns are causing some of the best defense industries to reduce their percentage of

defense work or withdraw completely from the defense market. There is also a growing concern that current methods utilized in supporting DOD profit policy have become outdated. Many DOD officials feel that competitive procurement, fixed-price contracting, and the Weighted Guidelines Method of arriving at a prenegotiation profit objective can not be used as effectively in today's environment as in the past.

Competitive Procurement

In many cases competition is no longer an effective technique for reducing government costs because the most efficient contractors are no longer bidding for the lower profit government contracts. Furthermore, there is a concern that the most efficient contractors are not selected to perform government effort because less capable contractors are submitting lower bids just to stay in business. In the long run this results in increased costs to the government.

Fixed-Price Contracting

Fixed-price contracting has become less effective due to inflation. While the use of fixed-price contracts during inflationary periods does not create as much of a problem if delivery is relatively short (six months or less), there are numerous contracts whose duration extends over several years. The further the delivery date from the date of award, the more troublesome the effect of inflation will be on the contractor.

Figure 3 shows the effects of inflation on the general level of prices (GNP deflator) from 1958 through 1975. From 1955 to 1965 general prices crept up at an average rate of 2% per year, and from

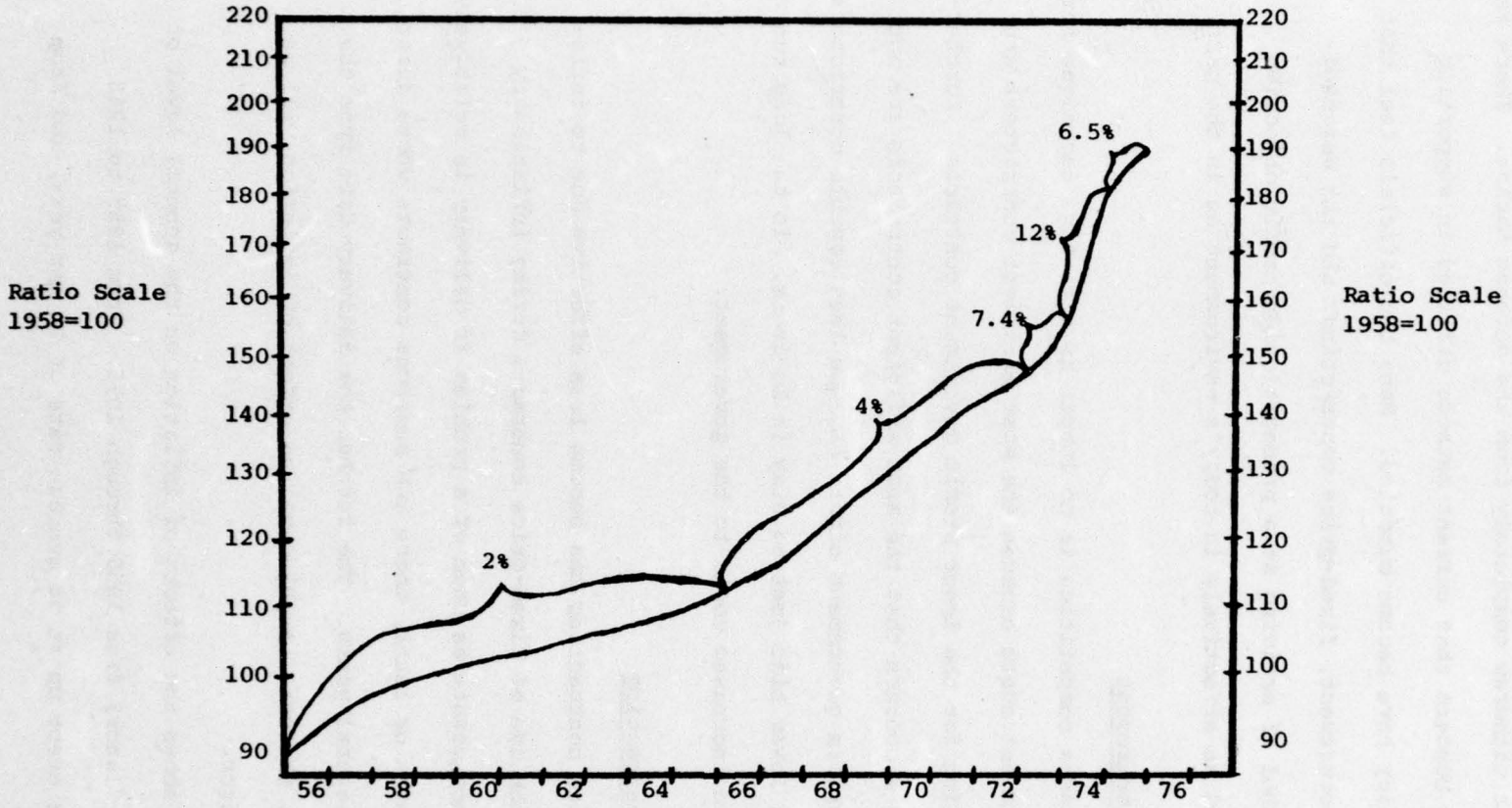


Fig. 3. General Price Index*

*As used in national income accounts. Percentages are annual rates of change for the periods indicated. (Adapted from Refs 43:9 and 44:7).

1965 to 1973 prices rose at an average rate of 4%. However, the rate of inflation was 7.4% in 1973, 12% in 1974, and 6.5% in 1975.

The uncertainty concerning what price levels will be in the future forces a contractor to estimate his costs on the basis of current dollars and add on an amount for the contingency due to inflation. (Ref 25:53). However, the significant fluctuations in the economy during the 1970's decreased the effectiveness of fixed-price contracting. Contractors frequently did not include enough contingency in their contract price to compensate for the abnormally high inflation experienced during contract performance. This resulted in contract costs approaching or exceeding their price ceiling, thereby reducing or causing a loss in the profit realized. Department of Defense officials stated that the projected cost of forty-two major weapon system programs showed an increase of $16.9 billion between March and June 1974, largely because of a more realistic appraisal of inflation rate increases. This raised the total cost of the projects to $143.6 billion. (Ref 14:14). Fixed-price contracting by itself does not provide the flexibility needed to cope with the effects of abnormal inflation on contract cost and profit objectives.

The Weighted Guidelines Method

The Weighted Guidelines Method for determining a prenegotiation profit objective was a ground-breaking policy when first implemented in 1964 and has been a very useful and important technique in DOD procurement operations. However, the Weighted Guidelines Method provides for a cost based profit policy, because the contractor's target profit varies directly with the cost estimate. If the cost estimate

goes up, so does the profit, and, conversely, as the cost estimate goes down, the profit does also. (Ref 28). The Weighted Guidelines Method was not responsive to contract differences in the amount of capital employed or in the turnover of capital employed. (Ref 30:3).

In order to deal with some of these problems, the basic Weighted Guidelines Method was modified in 1972 by Defense Procurement Circular (DPC) #107 to explicitly recognize the estimated amount of operating and facilities capital a contractor will employ in contract performance. However, voluntary applications of DPC #107 were few in number. The policy failed to attract support from industry because it did not adequately enhance the profitability of defense work compared to the basic Weighted Guidelines Approach. (Ref 30:4). Thus, the basic Weighted Guidelines Method is still used despite the fact that it does not adequately consider contract differences in the amount of capital employed or in the turnover of capital employed.

"Profit 76"

As a result of the problems encountered in recent years with the methods used to support DOD profit policy objectives, in 1975 the Department of Defense initiated action to begin another profit study. The study is called "Profit 76" and is scheduled to be completed around the middle of 1976. Some of the reasons that the DOD initiated the profit study are listed below.

1) The inflationary state of the economy is adversely affecting DOD profit policy objectives. (Ref 37:39).

2) The basic Weighted Guidelines Method is providing little motivation to reduce costs and little recognition of capital investment. (Ref 29).

3) There are signs indicating that the defense industrial base is eroding. Fewer contractors are competing for defense contracts and there has been little investment in assets designed to increase efficiency and productivity. (Ref 37:39-42).

4) Previous studies have indicated that profits on defense work have been generally lower than profits received for comparable commercial work.

5) The Cost Accounting Standards Board has initiated action in areas that will affect DOD profit policy.

The "Profit 76" team is expected to determine contractors' profitability in defense and nondefense business and to analyze the relation of earnings to capital investment. As Deputy Secretary of Defense Clements stated, "The end result of the study effort must be improvements in our profit policy which will directly and favorably act to strengthen our competitive industrial base." (Ref 29).

Economic Price Adjustment Clauses

Introduction

As previously mentioned, fixed-price contracting by itself does not provide the flexibility needed to cope with the effects of abnormal inflation on contract cost and profit objectives. However, an economic price adjustment clause can be incorporated into fixed-price contractual agreements to protect the government and contractor from significant economic fluctuations by providing for the adjustment of contract

prices during the life of the contract and after costs have actually been incurred.

Government Reluctance to Face Inflation

The Federal government has, however, been reluctant to face the problem of inflation. The Office of Management and Budget (OMB) Circular A-11 does not allow for the inclusion of future price increases in budget requests. The reasoning apparently is that to budget for inflation at a stated rate would be a self-fulfilling expectation. The provisions of this circular thus curtailed the use of escalation clauses on government contracts. However, the Department of Defense obtained an exception to the provisions of the OMB Circular A-11 which permitted the inclusion of inflationary costs within the overall established budget ceiling on major weapon systems and major constructions. (Ref 25:53). This exception thus increased the use of escalation clauses on major weapons systems fixed-price type contracts. Hence, in March of 1974 the DOD published Defense Procurement Circular (DPC) 120. The provisions of DPC 120 were included in the July 1, 1974 edition of the ASPR as Section 3.404.3 entitled "Fixed-Price Contract with Economic Price Adjustment." This section states the conditions under which purchasing contracting officers can use economic price adjustment clauses on fixed-price type contracts and establishes provisions for the three broad types of economic price adjustments addressed in the section.

Types of Economic Price Adjustment Clauses

The three broad types of economic price adjustment are adjustment based on established prices, adjustment based on labor or material

costs (actual cost method), and adjustment based on labor or material cost (cost index method). Provisions for adjustments based on either established prices or labor and material costs (actual cost method) have been in the ASPR for a number of years. (Ref 51:50). However, their use was restricted to fixed-price supply and service type contracts. Adjustments based on established prices were used on fixed-price supply contracts when an established catalogue or market price for adjustment could be verified. Adjustments based on labor or material costs (actual cost method) were authorized for use on fixed-price supply and service contracts only when there was no major element of design engineering or development work involved in producing the items being procured and one or more identifiable labor or material cost factors were subject to change. (Ref 45: Sec. 3-404.3).

Prior to the incorporation of DPC 120 into the ASPR, the ASPR did not provide sufficient guidance on the use of escalation clauses on fixed-price major weapon system contracts. Government and contractor representatives had to design their own escalation clauses and few chose to do so. (Ref 10). However, as a result of DPC 120, the July 1974 ASPR set forth guidelines under the cost index method for the application of escalation clauses on fixed-price major weapon system contracts. The cost index method is authorized for use when

> . . . 1) there will be an extended period of performance with significant costs to be incurred beyond one year after commencement of contract performance, 2) the contract amount subject to adjustment is substantial, and 3) the economic variables for labor and material are determined to be too unstable to reflect a reasonable division of risk between the parties without economic price adjustment provisions. (Ref 45: Sec. 3-404.3).

When the procurement situation meets these three guidelines, the ASPR addresses fourteen provisions to be considered in preparing the economic price adjustment clause. Major weapon system acquisition contracts primarily use adjustments based on labor and material costs using the cost index method. Therefore, subsequent references in this study to economic price adjustment clauses are intended to apply only to the cost index method.

Summary

The objectives of DOD profit policy are to utilize profit to stimulate efficient contractor performance and to attract the industrial capabilities needed to support national defense objectives. Over the last twenty years the defense procurement environment has changed considerably, and this has had an effect on the methods used to support profit policy objectives. Defense profit studies have been used to change and refine procurement methods in order to keep them current and provide for the effective conduct of defense profit policy.

The 1950's

During the 1950's sole source procurement and cost-plus fixed-fee contracting were frequently used to procure sophisticated weapon systems. However, sole source procurement made it difficult for the government to determine if the contractor was submitting a fair and reasonable price and cost-plus fixed fee contracting provided little motivation for the contractor to control costs. This led to public allegations of allowing defense industries to profiteer at the expense

of the taxpayer. Of course, these allegations directly challenged DOD profit policy objectives.

The 1960's

During the 1960's the DOD stressed the greater use of competition and fixed-price contracting. Competition enabled the government to compare contractor bids and award contracts to the lowest responsive and responsible bidder. Fixed-price contracting increased the dollar amount of profit a contractor could earn on a contract but it did so because it also increased the contractor's burden of financial risk. The shift to fixed-price contracting was made to motivate the contractor to control costs and thus reduce total costs to the government. The Weighted Guidelines Method of determining a prenegotiation profit objective was also implemented in the 1960's. This was done to give government contracting representatives greater guidance concerning the factors that ought to be considered in arriving at a contract profit objective.

Current Concerns

Profit studies conducted by the Logistics Management Institute and the General Accounting Office in the late 1960's and early 1970's revealed that profits on defense work were generally lower than profits received for comparable commercial work. As a result of these studies and fluctuations in the economy in the 1970's, there has been a growing concern within the Department of Defense community that the methods used to support profit policy objectives are not as effective as they should be.

In some cases, competitive procurement was eliminated or restricted because the most efficient contractors were no longer bidding for the lower profit government contracts. Fixed-price contracting has become less effective due to inflation. In many cases abnormally high inflation has caused cost overruns and low profit returns. The Weighted Guidelines Method has been criticized for being a cost based profit policy: it is not responsive to contract differences in the amount of capital employed or in the turnover of capital employed. These concerns have prompted the DOD to institute another profit study. This study is called "Profit 76." The end result of the "Profit 76" study is to recommend improvements in the methods used to support defense profit policy objectives.

Economic Price Adjustment Clauses

Fixed-price contracting by itself does not provide the flexibility needed to cope with the effects of abnormal inflation on contract cost and profit objectives. In response to this problem the 1974 ASPR regarding economic price adjustment clauses was updated. The changes made provided a method of adjustment (cost index method) to compensate for the effects of inflation on major weapon system fixed-price contracts.

CHAPTER II

RESEARCH OBJECTIVES AND METHODOLOGY

Background

Dollar Amount of Contract Price Subject to Adjustment

The ASPR addresses fourteen provisions that should be considered in preparing an economic price adjustment (EPA) clause based on the cost index method of adjustment. One of the provisions listed under the cost index method states that the contract should specify the dollar amount of the contract price subject to adjustment. The labor, material, and overhead portions of the contract must be examined to exclude any areas that do not require adjustment for escalation. This same provision also states that adjustments normally would not be applied to the profit portion of the contract. (Ref 45: Sec. 3-404.3).

If adjustments are not applied to the profit portion of a fixed-price type contract, the profit earned and the coming-out profit rate will be affected. Under abnormally high inflationary economic conditions, if only total contract costs are adjusted to compensate for the effects of inflation, the profit earned will stay the same, rather than increase. For example, a $10 million profit on costs of $100 million yields a 10% return on total contract costs. However, a $10 million profit on costs of $115 million yields only a 8.7% return on total contract costs. On the other hand, if abnormally low inflationary economic conditions materialize, the profit earned will stay the same, rather than decrease, and the coming-out profit rate will

increase. A $10 million profit on costs of $85 million yields an 11.8% return on total contract costs.

Methods of Adjustment

The method of adjustment can also influence the profit earned and the profit rate realized on a fixed-price type contract. On some contracts adjustments are made to contract prices for the difference between an actual index number and a projected index number. These adjustments are made for the effects of only abnormal inflation, because the projected index number reflects the normal inflation included in the contractor's price.

On other contracts in which projected index numbers reflect the normal inflation included in the contractor's price, upper and lower band index numbers are established around the projected index numbers. The upper and lower band index numbers are derived by increasing and decreasing the projected indexes by a percentage of their projected value. Adjustments are made to contract prices only if the actual index number is outside the upper or lower band index number and only for the difference between the actual index number and the upper or lower band index number. Adjustments are not made to contract prices for the difference between the upper and lower band index number and the projected index number. The abnormal inflation in the contract prices within the bands is shared in accordance with the government/contractor share ratio. Thus, a contractor will incur increased costs or savings depending on whether the actual index number is above or below the projected index number. Hence, the method of adjustment can affect the profit earned and the profit rates realized on fixed-price

type contracts. Furthermore, the government/contractor share ratio determines how the abnormal inflation in the contract prices within the bands is shared. Therefore, the government/contractor share ratio can also affect the profit earned and the profit rates realized on fixed-price type contracts.

Statement of the Problem

If contract economic price adjustment clauses reduce the profit earned on fixed-price type contracts, the affected contractors may be discouraged from bidding on future government effort or reduce capital investment in more efficient facilities and equipment. This would prevent the fulfillment of DOD profit policy objectives. On the other hand, if contract economic price adjustment clauses increase the profit earned, the affected contractors will receive a windfall profit. A survey on the use of economic price adjustment clauses was completed in the fall of 1975 by Headquarters, Air Force Systems Command. This survey indicated an extensive use of the cost index method of adjustment by the larger buying activities. (Ref 27). However, due to the cost index method's recent implementation, little research has been conducted regarding the effect of its provisions on contract profit.

Objectives of the Research

This study has three basic objectives. The first objective is to predict the effect of economic price adjustment clauses currently in use on selected fixed-price type contracts on the profit earned and the profit rates realized on these contracts. The second objective is to determine how varying the implementation of selected economic

price adjustment provisions affects the profit earned and profit rates realized on the contracts. A third objective is to perform a comparative analysis of the results obtained from the first two objectives in order to establish the relationships resulting from varying the selected EPA provisions.

Hypothesis

This study will test the hypothesis that differences in the way economic price adjustment provisions are implemented can affect the profit earned and profit rates realized on fixed-price type contracts and that these effects can be predicted.

Scope

Number of Contracts

As of April 1976 economic price adjustment clauses were being used on sixty-five Air Force fixed-price type contracts. Of these sixty-five contracts, forty were firm fixed-price contracts and twenty-five were fixed-price incentive contracts. The cost index method of adjustment was being used on all twenty-five of the fixed-price incentive contracts and twenty-one of the forty firm fixed-price contracts. (Ref 16).

The data needed to support this research effort were available from the Aeronautical Systems Division Procurement and Production Pricing Directorate and from program offices within the Aeronautical Systems Division. The Aeronautical Systems Division is currently using economic price adjustment clauses on nineteen of the contracts it is administering. Of the nineteen contracts, four were selected

for inclusion in this study. The four selected are representative of the nineteen contracts using an EPA clause with respect to contract type, dollar value, duration, and method of adjustment.

As requested by program personnel, an A, B, C, D designation will be used for identifying the four contracts. The selected bibliography also uses a letter designation for program documentation and personnel interviewed.

Current Data

The decision was made to analyze the effects of economic price adjustment clauses and selected provisions of these clauses on the profit earned and the profit rates realized on contracts that were in progress as of 30 March 1976. This decision was made for several reasons.

1) Economic price adjustment clauses were seldom used on major weapon system contracts prior to 1974.

2) The EPA clauses in use prior to 1974 varied significantly from each other.

3) The economic environment during the last five years is not representative of the projected economic environment for the next five years.

Provisions Selected for Analysis

Three economic price adjustment provisions were selected for analysis. They are the dollar amount of contract price subject to adjustment, the width of the band percentage, and the government/contractor share ratio. The analysis pertaining to the dollar amount of contract price subject to adjustment investigates only whether profit

is subject to adjustment. No attempt is made to determine whether the proper amount of costs are subject to adjustment. While other EPA provisions may affect the profit earned and the profit rates realized on the selected fixed-price type contracts, analysis was limited to the above three provisions due to research time constraints.

Limitations

Measures of Profitability

Several measures of profitability are normally used by both commercial and government enterprises to establish if enough profit is being earned for services rendered. Typical measures of profitability include profit margin, return on total investment, and return on owner's equity. Information to support these measures is not only difficult to obtain at the contract level, but, in the context of this study, actual data were not available to support these calculations. Thus, the measures of profitability used in this study are limited to the amount of profit earned and return on cost.

Number of Contracts

As previously mentioned, four contracts were selected for inclusion in this study. The findings presented in this study apply to the four contracts. Generalizations of these findings to other contracts should be closely examined for applicability.

Assumptions

Several assumptions were made in order to support the accomplishment of the research objectives. The assumptions pertaining to contract

cost and profit, EPA provisions, and contract performance are addressed below. The assumptions relating to predicting future rates of inflation and including profit in the dollar amount of contract price subject to adjustment are presented in subsequent chapters. These latter two assumptions are discussed where they will be more easily understood and where they are needed to support quantitative computations.

Contract Cost and Profit

The assumption is made that there will be no change to contract ceiling price, cost, or profit other than (1) for adjustments required in accordance with contractual EPA provisions or (2) for increases in contract prices resulting from inflation which are not subject to economic price adjustment. This assumption is necessary in order to isolate the effects of the various contract EPA clauses and selected provisions of these clauses on contract profit.

Economic Price Adjustment Provisions

It is not current policy to allow for changes to economic price adjustment provisions after a contract is awarded. Nevertheless, changes have been made in contract EPA provisions under certain circumstances (e.g., delays in exercising production options). The assumption is made that all of the economic price adjustment provisions identified in the contracts will be upheld without change.

Contract Performance

While a contractor's performance does affect the profit earned on fixed-price type contracts, the purpose of this study is to analyze the effects of the various contract EPA clauses and selected provisions

of these clauses on contract profit. In order to isolate these effects, the assumption is made that each contractor performs in accordance with his time-phased budget plan. Therefore, the effects of performance on profit are not considered in this study.

A Qualification to the Assumptions Made

The assumptions pertaining to contract cost and profit and economic price adjustment provisions must be qualified for Contracts A and D. Changes were made regarding contract cost and profit and EPA provisions in order to incorporate contract modifications affecting the number of purchased products and the delivery of these products. For Contracts A and D the target cost and profit and the dollar amount of contract price subject to economic price adjustment, which are presented in this study, are in consonance with the revised contract baselines and the assumptions addressed in the last section are applicable to the revised contract baselines.

Research Plan

Sources of Information

A thorough understanding of economic price adjustment provisions, contract data, and indexing procedures was necessary in order to accomplish the research objectives. To achieve this understanding a review of the literature was accomplished and interviews were conducted with numerous Air Force Systems Command personnel. Among the personnel interviewed were program contracting and finance officers and key personnel in various support agencies whose knowledge of economic price adjustment provisions and indexing procedures is well recognized.

Though not all of the interviews are referenced in the body of this study, all provided insight relevant to the topic area. Therefore, all of the interviews are contained in the Bibliography.

The Mechanics of an EPA Clause

A knowledge of how economic price adjustment clauses work is a prerequisite to understanding the computations performed to determine the effect of the various EPA clauses and selected provisions of these clauses on contract profit. The third chapter of this study explains various economic price adjustment provisions. It also presents the formulas that will be used in subsequent chapters to determine adjustment dollar amounts.

Data Collection and Verification

As previously mentioned, the contractual data needed to support this study were obtained from the Aeronautical Systems Division Procurement and Production Pricing Directorate and program offices within the Aeronautical Systems Division. The data included economic price adjustment contract clauses and information relating to contract EPA provisions. Contract cost and profit data were also obtained. The data obtained for use in this study were verified with program personnel and changes were made where inaccuracies existed.

Predicting Inflation

The four contracts selected for analysis in this study are currently in progress. Adjustments have been made on each of these contracts through December 1975, because the actual index numbers used to determine the dollar amount of adjustment have been published

through December 1975. However, adjustments must still be made for the inflationary increases in contract prices which will be incurred by the contractor during the remaining contract time period. Therefore, a method of predicting the future rate of inflation on each of the contracts was determined. The selected method is discussed in Chapter Four.

Quantitative Computations

Once the method of predicting the future rates of inflation was determined, a five step process was used to present the quantitative computations made in deriving the effect of each of the contractual EPA clauses on contract profit. The five step process starts with presenting the basic contract data and ends with the computation of the profit earned and profit rates realized. This five step process is utilized for each of the four contracts, however, only the five step process for Contract D is presented in Chapter Four. The quantitative computations in support of Contracts A, B, and C are presented in Appendices A, B, and C respectively.

Hypothetical EPA clauses were then developed by varying the selected provisions of the contractual EPA clauses. The EPA provisions varied were: the dollar amount of contract price subject to adjustment, the width of the band percentage, and the government/contractor share ratio. The quantitative computations made in deriving the effects of the hypothetical EPA clauses on contract profit are not presented in this study. This is because the computations for the hypothetical EPA clauses follow the same five step process that is demonstrated using the contractual clauses. The only difference

between the contractual EPA clauses and the hypothetical EPA clauses is that selected EPA provisions are varied one at a time (to the extent possible) to determine how each modified provision affects contract profit earned and the profit rates realized. In some cases both the band width and the government/contractor share ratio are varied. The changes made to each of the provisions are discussed in detail in Chapter Five before presenting the results of the quantitative computations.

The results obtained from the quantitative computations performed for this study support the fulfillment of the first two research objectives. The first objective is to predict the effect of EPA clauses currently in use on selected fixed-price type contracts on the profit earned and the profit rates realized on these contracts. These results are presented in Chapter Four. The second objective is to determine how varying the implementation of selected EPA provisions affects the profit earned and the profit rates realized on the contracts. These results are presented in Chapter Five.

Comparative Analysis

The third research objective is to perform a comparative analysis of the results obtained from the first two objectives in order to establish the relationships resulting from varying the selected EPA provisions. This objective is accomplished in Chapter Five. For each provision varied the profit earned and profit rates realized while following the contractual and hypothetical EPA clauses are compared. Also, the profit earned and the profit rates realized while varying

each of the three selected EPA provisions are compared with each other. Relationships evolving from the comparative analysis are established.

A Prior Study

A research study entitled "A Comparative Analysis of the Parameters of Economic Price Adjustment Clauses" was completed in August 1975 by Major Joseph Scarlett and Captain Kenneth Faulhaber for the Air Force Institute of Technology. The objective of their thesis was to analyze commonly used EPA parameters (provisions) in order to identify the effect they have on the cost of a contract. To accomplish their objectives they created a hypothetical contract environment covering the years 1970-1974. They then varied six parameters to determine the impact of each parameter on contract cost. (Ref 32).

This study is similar to the Scarlett and Faulhaber study in that it also determines the effect of EPA clauses and selected provisions of these clauses on contract cost. Also, the three provisions analyzed in this study are among the six provisions analyzed in the Scarlett and Faulhaber study. However, this study differs from their study in several ways.

1) Economic price adjustment clauses that are currently in use on four fixed-price type contracts are analyzed.

2) The hypothetical EPA clauses analyzed herein are baselined to the actual contractual EPA clauses. Differences exist only to the extent that changes are made to the selected provisions of the contractual clauses.

3) Since the contracts selected for inclusion in this study are in progress, the future rate of inflation on each of the contracts is predicted.

4) Emphasis is placed on analyzing what effect the EPA clauses have on the profit earned and the profit rates realized on the contracts.

5) Since the contracts included in this study have durations spanning the time period from 1974 to 1981, the economic conditions in which the clauses are analyzed are different.

CHAPTER III

THE COST INDEX METHOD OF ADJUSTMENT

Background

The cost index method of adjustment is used on major weapon system fixed-price type contracts to protect the contractor and the government against significant economic fluctuations in contract prices. The provisions identified in the ASPR 3-404.3 concerning the cost index method resulted from experience gained on prior Air Force Systems Command and Navy contracts and from studies conducted in the late 1960's and early 1970's. The results of these studies are presented below.

Logistics Management Institute Study

In May of 1968 the Logistics Management Institute (LMI) published a study addressing when to use escalation clauses, as opposed to contingency factors for uncertain price levels, and the problem of the proper structure of those clauses. The Institute's major recommendations were:

1) The use of escalation provisions is generally to be preferred to adding estimates of future price level changes in contract prices.

2) Indexes should encompass the widest possible industrial base compatible with the objectives of escalation provisions to avoid the possibility that contractors may influence the index and that escalation adjustments may contribute to spiraling price levels.

3) Escalation provisions should not require audit or statement of actual costs as a condition for applying the escalation adjustment.

4) Escalation provisions should be included in all multi-year procurement contracts and in contracts containing priced options.

5) Studies should be made to determine the appropriate labor and material indexes for . . . major commodity areas where long-term contracts are employed. (Ref 24:3).

These recommendations resulted primarily from LMI's conclusions that "constant dollar" pricing was the preferred method of paying for escalation. With constant dollar pricing the contract price is bid in current year dollars and adjustments are made for the effects of both normal and abnormal inflation on contract price. Further recommendations included that compensation should be provided only for fluctuations in the economy due solely to general economic trends and outside the influence of the individual contractor, and that suitable indexes could be chosen or constructed to reflect such trends. Additionally, LMI recommended that 1) there should be no ceiling or floor on the amount of adjustment provided by an escalation clause, 2) such adjustments should be made without regard to contract delivery date, 3) the target cost and ceiling price should be reset to reflect escalation, and 4) an increment of profit should be included in any escalation adjustment. (Ref 24:53-57).

RAND Corporation Study

In December 1970 H. G. Campbell of the RAND Corporation completed a study for the United States Air Force entitled Aerospace Price Indexes. The study developed a basic methodology for constructing aerospace indexes. The indexes were derived from the Bureau of Labor Statistics Wholesale Price Index and Wage Surveys. Some of the indexes developed were for aircraft materials, aircraft parts, and

hourly wages of various aerospace related skills. He combined these indexes into various composite indexes including aircraft price, electronics and communication equipment price, and missile and spacecraft price, thereby developing indexes relating specifically to aircraft, missile, and electronic development. (Ref 5:1-22).

Air Force Study

In July 1973 David W. Krahenbuhl and Michael B. McDonald completed another study concerning the construction of indexes. It is essentially a report discussing various characteristics of index numbers and making general recommendations concerning their use in defense contracting. They suggest that the Wholesale Price Index is the best source of information when constructing indexes for defense contracts. The conclusions of their study are basically consistent with the Campbell methodology. (Ref 17:44-45).

Economic Price Adjustment Provisions

The results of these studies provide background information on the environment leading up to the time in which the provisions for the cost index method were developed and incorporated into the ASPR. While it was originally intended to develop specific provisions for the cost index method of adjustment, it soon became apparent that each procurement action would vary and the provisions would have to be tailored to fit the needs of each contract procurement. (Ref 51:1). The provisions as presented in the ASPR are grouped and summarized below to communicate the basic information needed to understand the analysis which follows in subsequent chapters.

Provisions Relating to Timing

The economic price adjustment clause should provide for adjustment from the beginning of the contract or from a period of time in which the adjustment provided is commensurate with the administrative cost and effort to adjust. The clause should not provide for adjustment beyond the original contract performance period as adjustments should be based on a predetermined time phased expenditure profile which supports the original contract completion date. (Ref 45: Sec. 3-404.3).

Definite times for price adjustment should be established. Adjustments should be of such frequency so as to afford the contractor appropriate economic relief without at the same time creating a burdensome administrative effort. The adjustment period should normally range from a minimum of quarterly to a maximum of annually. (Ref 45: Sec. 3-404.3).

Provisions Relating to the Dollar Amount of Contract Price Subject to Adjustment

The clause should state the dollar amount of contract price subject to adjustment. Normally, adjustments should not be applied to the profit portion of a contract. Furthermore, the labor and material costs of the contract must be examined to exclude costs that do not require adjustment. For example, firm-fixed price subcontract costs or direct labor costs for a period of time in which a definitive union agreement exists should not be included in the dollar amount subject to adjustment. Some overhead costs should also be excluded. Depreciation charges, prepaid insurance costs, rental costs, leases, certain taxes, and utility charges are some areas that should be examined in

detail. The dollar amount of contract price subject to adjustment should remain fixed through the life of the contract except in the event of partial termination of the contract. Changes in contract price resulting from configuration control and engineering change proposals or other provisions of the contract will be priced as though there were no provision for economic price adjustment. (Ref 45: Sec. 3-404.3).

Provisions Relating to Expenditure Profiles

The dollar amount of contract price subject to adjustment should be separated into labor and material expenditure profiles. The expenditure profile for both labor and material should include both direct and indirect costs and be based on a predetermined rate of expenditure in lieu of actual costs incurred. The dollar amount of labor and material should then be allocated to specific periods of time (e.g., quarterly, semiannually, etc.) based upon the most probable expenditure or commitment basis. (Ref 45: Sec. 3-404.3).

Provisions Relating to Price Indexes

Normally not more than two price indexes should be used--one for application to the labor expenditure profile and one for application to the material expenditure profile. The clause must have a positive and accurate identification of the applicable index(es) upon which adjustments will be based and address procedures to be followed in the event of discontinuance or changes in the index from which adjustments are made. (Ref 45: Sec. 3-404.3).

If a price index is to serve as a stable basis for comparison of price movements over time, a base period comparable to the contract

periods for which adjustments are to be made must be identified as a reference point for application of an index. A series of indexes for subsequent periods can then be generated from the base period index in order to compare indexes during those periods not only with the base period index but also with each other. (Ref 45: Sec. 3-404.3).

Construction of an index is largely dependent upon two general series published by the United States Department of Labor, Bureau of Labor Statistics (BLS). These series are the Industrial Commodities portion of the Wholesale Price Index for material and the Wage and Income Series by Standard Industrial Classification for labor. Since there are no BLS published series currently available that relate directly to total prices of delivered aircraft, ships, missiles, etc., composite indexes from the two series described above should be made. The index(es) should be structured to encompass a large sample of relevant items, yet bear a logical relationship to the type of contract cost being measured. The composition of the index should not be so large and diverse that it is significantly affected by fluctuations not relevant to the contract performance. Yet, it must be significantly broad so as to insure the minimal effect of any single company, including the anticipated contractors. (Ref 45: Sec. 3-404.3).

Cost Incentive Provision

When a contract contains cost incentives, the contractor will not be penalized for any sums paid to him as a result of the EPA clause. The dollar amount of adjustment provided shall be subtracted from the total costs to which cost incentive provisions apply. (Ref 45: Sec. 3-404.3).

Cost Index Methods of Adjustment

Under the Cost Index Method there are three different methods of adjustment that are frequently used. The phrases used in this study to refer to these methods of adjustment are the constant dollar method, the total abnormal method, and the partial abnormal method. The total abnormal and partial abnormal methods of adjustment have been briefly discussed previously in Chapter Two.

The Constant Dollar Method of Adjustment

With the constant dollar method of adjustment the contractor's proposal is submitted in current year dollars, as if he expects price levels to remain constant. This means that the proposal does not include any contingency for future price changes. Therefore, adjustments to the contract price are made for both normal and abnormal inflationary impacts. The adjustment formula is

$$\text{ADJ.} = \frac{\text{Actual Index} - \text{Base Index}}{\text{Base Index}} \text{ X Projected Costs} \qquad (1)$$

where the actual index is the average numerical value of the index identified for adjustment for the time period covered, the base index is the average numerical value of the same index for the base time period, and the projected costs are the dollar amount of contract price subject to adjustment for the time period covered (in current year dollars).

The Total Abnormal Method of Adjustment

With the total abnormal method the contractor's proposal includes a normal amount of inflation and projected index numbers are used to

reflect the normal inflation included in the proposal. Thus, adjustments are made from the projected index numbers and are "only" for the abnormal effects of inflation. The formula used for the total abnormal adjustment is

$$\text{ADJ.} = \frac{\text{Actual Index - Projected Index}}{\text{Projected Index}} \text{ X Projected Costs} \quad (2)$$

where the actual index is the average numerical value of the index identified for adjustment for the time pericd covered, the projected index is the estimated average numerical value of the index for the time period covered, and the projected costs are the dollar amount of contract price subject to adjustment over the time period covered (includes normal inflation).

The Partial Abnormal Method of Adjustment

The partial abnormal method is similar to the total abnormal method in that the contractor's proposal includes a normal amount of inflation and projected index numbers are used to reflect the normal inflation included in the proposal. However, adjustments are not made from the projected index numbers. A band is established above and below the projected index numbers and no adjustment is made unless the actual index number exceeds the high band index number or falls below the low band index number. Upper and lower band index numbers are derived by increasing or decreasing the projected index numbers by a percentage of their projected value. The abnormal inflation which occurs within the band is shared in accordance with the government/contractor share ratio. An adjustment is only made for the difference

between the actual index and the upper or lower band index number. The formula used for the partial abnormal adjustment is

$$\text{ADJ.} = \frac{\text{Actual Index} - \text{Upper (or Lower) Index}}{\text{Projected Index}} \times \text{Projected Costs} \quad (3)$$

where the actual index is the average numerical value of the index identified for adjustment over the time period covered, the projected index is the estimated average numerical value of the index over the time period covered, the upper and lower band index numbers are calculated from the projected index numbers, and the projected costs are the dollar amount of contract price subject to adjustment over the time period covered (includes normal inflation).

Limitations of Price Indexes

Since this study involves the use of price indexes, it is only proper that the limitations of price indexes be addressed. Some of the major limitations associated with index construction involve the indexes' lack of ability to account for changes in quality, tastes, and productivity as well as their inability to accurately represent what it is they are supposed to be measuring.

Changes in Quality

One of the most difficult problems to resolve in price index construction is the need to adjust the "market value" (items on which the index is based) to reflect technological change which affects the quality of the items included in the market basket. Part of the price increase in items is due to quality improvements and should somehow be eliminated in measuring the price change associated with the

original market basket. However, attempts to adjust out the portion of the price change attributable to quality changes has become more difficult in recent years due to rapid technological progress. (Ref 50:35).

Changes in Taste

Closely related to the limitation caused by quality changes is the matter of changing tastes over time. If an individual gets more utility from a product or service this year than he did last year, the individual would be willing to pay a higher price. (Ref 11:18).

Changes in Productivity

Changes in productivity can also limit an index's ability to accurately project price level changes. For example, if the price of labor remains constant, but productivity increases per unit of labor input, the actual cost of a unit of output will decrease. When an index measures changes in the level of wages and salaries, rather than changes in the price of service rendered, the effect of productivity on the index is neglected. (Ref 20:172).

Index Composition

The final limitation has to do with the degree to which the index accurately represents what it is supposed to be measuring. Does it include the proper mix of goods and services, measure the proper population, etc.? (Ref 34). As previously mentioned, there are no indexes developed to measure price level changes in DOD products. Thus, DOD procurement officers identify and select indexes from the government published indexes which are relevant to their product. This appears

to be the best available alternative in dealing with this index limitation.

Projecting Index Numbers

The government and the contractor arrive at the indexes to be used to adjust the dollars in the labor and material expenditure profiles for inflationary effects during contract negotiations. The contractor usually suggests the labor and material index(es) which he feels best portrays the inflationary increase in his labor wage rates and commodity prices based upon historical data. The government then analyzes the data submitted by the contractor to determine its validity.

For example, the contractor may claim that the average increase in his labor wage rates over the past five years has been 6% and that the Standard Industrial Classification (SIC) Code 37, average hourly earnings for production workers in manufacturing transportation equipment, correlates best with this 6% increase. The procuring office first analyzes the contractor's historical labor wage rate data to verify the 6% average labor rate growth. Once the labor wage rate growth has been verified, a regression analysis is usually performed using the historical BLS SIC Code 37 data as the independent variable and the contractor's time series historical average labor wage rate data as the dependent variable. If the regression analysis indicates that the slope value is not representative of the contractor's 6% average labor rate growth, the negotiations and analysis process continues until a more representative SIC Code can be determined and accepted by both parties. If the regression analysis indicates that the slope value is close to 6%, the BLS SIC Code 37 is accepted as a proper method of

adjusting for the effects of inflation on the dollars in the contractor's labor expenditure profile.

The BLS SIC Code 37 base period index number is then compounded at a 6% annual rate to determine the projected index numbers for adjustment. The projected index numbers are then incorporated into the contract. The dollars in the labor expenditure profile will include the compounded 6% normal inflationary rate impact on labor costs. Adjustments will be made based upon an abnormal variance above or below the projected index numbers at the time the appropriate actual BLS index numbers are available and in accordance with other contract economic price adjustment provisions.

If a constant dollar method of adjustment is used, the government and contractor must still identify BLS indexes which correlate well with the labor and material price increases reflected in the contractor's historical cost data. Thus, the same process as addressed above is followed with the exception of projecting future index numbers from the base period index number. Only the base index number needs to be determined since the constant dollar method of adjustment uses the base period index number rather than a projected index number for adjustments.

Summary

The cost index method provides a means of adjusting prices on major weapon system fixed-price type contracts during periods of significant economic fluctuation. Of the topics addressed in this

chapter, economic price adjustment provisions and methods of adjustment are most important.

Prior to contract award, the government and the contractor must agree to numerous economic price adjustment provisions. The period of contract performance for which the adjustments will apply must be determined as well as the number of adjustment time periods. The dollar amount of contract price subject to adjustment must be decided and expenditure profiles developed. The expenditure profiles are developed by dividing the dollar amount of contract price subject to adjustment into labor and material categories and allocating the dollar amount in each of the categories to appropriate adjustment time periods. The government and contractor must also agree on the indexes to be used for making adjustments to the dollar amounts in the expenditure profiles. The indexes selected should correlate well with the labor and material price increases reflected in the contractor's historical data. Once the indexes to be used for making adjustments are determined, base period index numbers can be established.

Under the cost index method, any one of three different methods of adjustment can be used. These methods are the constant dollar method, the total abnormal method, and the partial abnormal method.

The formula for the constant dollar method provides for adjustment based upon the difference between the actual index number and the base index number. This is because the dollars in the expenditure profiles are priced in base year dollars.

The formula for the total abnormal method provides for adjustment based on the difference between the actual index number and the projected index number. This is done because the expenditure profiles

include a normal amount of inflationary dollars which are reflected by the projected index numbers.

The formula for the partial abnormal method provides for adjustment based on the difference between the actual index number and either an upper or lower band index number. The expenditure profiles include a normal amount of inflationary dollars which are reflected by projected index numbers. The band index numbers are derived by increasing or decreasing the projected index numbers by a percentage of their projected values. The abnormal inflation which occurs within the band is shared by the government and contractor in accordance with contract provisions.

CHAPTER IV

QUANTITATIVE COMPUTATIONS PERFORMED TO DERIVE THE EFFECTS ON PROFIT

Introduction

The purpose of this chapter is to predict the effect of economic price adjustment clauses currently in use on four fixed-price type contracts on the profit earned and the profit rates realized on the contracts. To accomplish this objective, a series of quantitative computations are performed.

Presentation

Five basic steps are used to present the quantitative effort performed in this study. The five steps are as follows:

1) present supporting contract data;
2) show computations supporting adjustments to date;
3) predict the actual indexes for future adjustments;
4) calculate the remaining adjustments; and
5) determine the impact on profit earned and the profit rate realized.

This five step process is followed for each of the contracts analyzed; however, only the quantitative computations relating to Contract D are presented in this chapter. Computations supporting Contracts A, B, and C are included in Appendices A through C respectively.

Selection of Contract D. The quantitative effort relating to Contract D was chosen for inclusion in this chapter because Contract D is

a fixed-price incentive firm contract which uses the total abnormal method of adjustment. This combination of contract type and method of adjustment was most frequently encountered among the nineteen contracts originally reviewed for possible inclusion in this study. Furthermore, Contract D uses a composite index for material adjustments which is more difficult to understand than when a single index is used for adjustment. Hence, an understanding of the computations performed on Contract D provides the knowledge needed to follow the similar but less complex computations performed on Contracts A through C.

Background

Contract A is a fixed-price incentive firm contract which uses the partial abnormal method of adjustment. Thus, adjustments are made for the difference between the actual index number and either the upper or lower band index number. Contracts B and C use the constant dollar method of adjustment. Hence, adjustments are made for the difference between the actual index number and the base index number. Contract B is a fixed-price incentive firm contract and Contract C is a firm fixed-price contract.

Method Used to Predict Future Rates of Inflation

Since all four contracts have remaining adjustments, a method of predicting the future rate of inflation on each of the contracts had to be determined. The Aeronautical Systems Division (Comptroller) publishes a Cost Escalation Report intended to provide current aeronautical economic escalation indexes reflective of the changing economic environment in which the aerospace industry operates. This report has been approved by the ASD Commander, Air Force Systems

Command, and Headquarters, USAF for use in preparing program estimates and budget submissions.

Discussions with program representatives revealed that a hybrid method is frequently used to predict the inflationary impact on program costs. (Refs 1; 3; 19). This hybrid method uses forecasted inflationary rates from the ASD Cost Escalation Report, program and contractor sources, and Assistant Secretary of Defense (Comptroller) publications. In order to standardize the approach used to predict the rate of inflation on each of the four contracts, the decision was made to use the ASD Cost Escalation Report (No. 110-C) dated April 1976.

The Cost Escalation Report contains six composite indexes based to FY 1975 which project aerospace inflation rates for the next ten years (FY 76 through FY 85). The six composite indexes are for airframe, engine, and avionics research and development and production effort. Each composite index contains labor, material, and overhead components. (Ref 9). Thus, the predicted rate of increase in contract labor and material indexes used in this report are the same.

Assumptions Relating to Inflation

An assumption was made that the BLS indexes selected to reflect the increase in prices the contractor incurs during the performance of the contract do actually project the inflation that is incurred during the performance of the contract. Thus, there will be no impacts on contract profit resulting from inflation rates that are different from the inflation rates projected by the selected BLS indexes. Furthermore, since the BLS indexes have not been published for future adjustments, an additional assumption is made that the escalation rates

projected in the ASD Cost Escalation Report (110-C) are as representative of what the future BLS indexes will be as rates projected by other methods.

Contract D Supporting Contract Data

Table III shows supporting data relating to Contract D. These data were obtained from the Aeronautical Systems Division Procurement and Production Pricing Directorate and program offices within the Aeronautical Systems Division. Data were verified through interviews with program procurement and finance representatives. Of particular importance is the target profit of $37,057,980 and the going-in profit rate of 11%. These figures will be compared with coming-out figures at the conclusion of the quantitative process. Also worthy of note is that of the $373,948,806 contract price, $329,637,000 is subject to economic price adjustment. The dollar amount subject to adjustment includes both direct and indirect costs; however, it does not include any dollars for profit, depreciation, equipment rental, or utilities. The dollar amount subject to adjustment is divided into the labor and material classifications and allocated to the appropriate adjustment period as shown in the expenditure profiles.

Base Index Numbers

As identified in section 9a, the index chosen to reflect price level increases in labor costs was SIC Code 3721. Standard Industrial Classification Code 3721 depicts the average hourly earning of production workers in the aircraft industry. The index base value was established at $5.52, the actual index number in July 1974. The projected index reflected under section fourteen depicts the cumulative

TABLE III

Contract D Data

1) Contract Type FPIF		2) Ceiling Price $437,958,074
3) Contract Price $373,948,806		4) Contract Target Cost $336,890,826
5) Target Profit $37,057,980	6) Going-in Profit Rate 11%	7) Share Ratio 90/10
8) Total Amount Subject to EPA $329,637,000		8a) Labor Amount: $245,025K 8b) Material Amount: $84,612K
9) BLS Indexes	9a) Labor SIC Code 3721 Base Value = $5.52 - July 1974	
	9b) Material - WPI: Composite Index Base Value = 149.07 - July 1974	

	Material		Labor	
10) Adjustment Period	11) Expenditure Profile	12) Projected Index	13) Expenditure Profile	14) Projected Index
Base		100.00		100.00
Jan-Jun 75	$ 2,952K	106.73	$ 12,123K	108.23
Jul-Dec 75	11,398K	110.40	27,798K	112.20
Jan-Jun 76	17,652K	113.23	35,703K	114.63
Jul-Dec 76	31,577K	115.95	54,824K	116.95
Jan-Jun 77	18,682K	118.57	60,159K	119.16
Jul-Dec 77	1,963K	121.93	38,725K	121.96
Jan-Jun 78	388K	125.91	11,748K	125.37
Jul-Dec 78	-----	130.11	3,273K	128.91
Jan-Jun 79	-----	134.40	672K	132.58
Total	$84,612K		$245,025K	

(Refs 13; 18; 19; 42)

time phased forecasted increase from the $5.52 base figure agreed to by both contracting parties. The projected index numbers represent the average index numbers for each of the time periods covered (on this contract six months) and occur midway through the time periods covered.

The base index number for material is a composite value. Table IV shows how the composite value was calculated. The indexes included in the composite material index and their respective weights were determined by the type and amount of material being used in the contract product and the amount of material purchased from vendors. The top four index numbers are July 1974 numbers for the identified Wholesale Price Index Industrial Commodities classifications. The purchased parts (SIC Code 3723-9) Index number was converted from average hourly earnings to a percentage of the 1967 base earnings per hour of $3.35. In other words the July 1974 average hourly earnings were 149.55% higher than the $3.35 1967 average hourly earnings. The projected index numbers reflected in Table III under section twelve depict the cumulative time phased forecasted increases from the 149.07 base figure agreed to by both parties.

TABLE IV

Computing Material Index

Index	% of Index		July 1974 Indexes		Weighted Values
Finished Steel Products 1013-02	5%	X	181.6	=	9.08
Primary Aluminum/NLDT 1022-0101-06	16%	X	156.8	=	25.09
Titanium Sponge 1022-0156-02	18%	X	137.2	=	24.70
Carbon & Graphite Products 1179-03	10%	X	139.3	=	13.93
Purchased Parts Employment & Earnings (SIC 3723-9)	51%	X	149.55	=	76.27
Material Base Index Number	100%				149.07

(Ref 42)

Contract D Adjustments to Date

The actual BLS index numbers for the indexes used for adjustment have been published for the first two adjustment periods. This information, along with the appropriate information from Table III is reflected in the computations shown below.

$$\text{ADJ.} = \frac{\text{Act. Ind. (L)} - \text{Proj. Ind. (L)}}{\text{Proj. Ind. (L)}} \text{ (Expnd. Prof. (L))} +$$

$$\frac{\text{Act. Ind. (M)} - \text{Proj. Ind. (M)}}{\text{Proj. Ind. (M)}} \text{ X (Expnd. Prof. (M))} \qquad (4)$$

$$\text{1st ADJ.} = \frac{109.48 - 108.23}{108.23} (\$12{,}123\text{K}) +$$

$$\frac{111.96 - 106.73}{106.73} (\$2{,}952\text{K}) = \$284{,}668 \qquad (5)$$

$$\text{2nd ADJ.} = \frac{114.82 - 112.20}{112.20} (\$27{,}798\text{K}) +$$

$$\frac{118.19 - 110.40}{110.40} (\$11{,}398\text{K}) = \$1{,}453{,}376 \qquad (6)$$

The first adjustment increased target costs, target price, and ceiling price by $284,668, the second by $1,453,376. However, no change was made to the $37,057,980 profit objective. This is because profit is not included in the dollar amount of contract price subject to adjustment and thus is not included in the labor and material expenditure profiles.

Predicting the Actual Index for Future Adjustments

A five step process is used in this study to predict the actual indexes for future adjustments. The process involves:

1) establishing new index numbers at 1 January 1976;

2) predicting the future rate of change in contract prices;

3) determining the actual index number at the midpoint of the adjustment period;

4) calculating the change in the index number from the new base index; and

5) multiplying the change factor from step four times the new base index number.

The step by step approach follows.

Establishing New Base Index Numbers

Since the actual BLS index numbers used for making adjustments have been published through the first two adjustment periods (January-June 1975, July-December 1975), there was no need to predict the inflation in the labor and material adjustment index numbers from July 1974 through December 1975. New base index numbers were established at 1 January 1976 and the actual index numbers for future adjustments were predicted from the new base index numbers.

To establish the new labor and material index numbers at 1 January 1976, an average of the appropriate index numbers for November and December of 1975 and January of 1976 was derived from published BLS data. Table V shows what the average index numbers were. The average index number for labor was then divided by $5.52 (from Table III, section 9A) to arrive at the new base index number of "117.03." The five average index numbers for material were weighted in the same

TABLE V

Average Labor and Material Index Numbers

Classification	Time Period Nov 75	Dec 75	Jan 76	Average Index Numbers
Labor				
SIC Code 3721	$6.43	$6.47	$6.48	$6.46
Material				
Finished Steel 1013-02	201.5	201.6	201.5	201.5
Primary Aluminum 1022-0101-06	162.9	164.3	166.1	164.4
Titanium Sponge 1022-0156-02	194.9	194.9	194.9	194.9
Carbon & Graphite Products 1179-03	203.0	203.3	203.3	203.2
Purchased Parts SIC Code 3723-9*	172.24	173.43	172.83	172.84

*The SIC Code 3723-9 index numbers were derived by dividing their average hourly earnings values for November, December, and January by the 1967 average hourly earnings value of $3.35. (Refs 48 and 49).

manner as shown previously in Table IV to arrive at a composite average material index number of 179.93. The composite material index number was then divided by 149.07 (from Table III, section 9b) to arrive at the new base index number of "120.70."

An Assumption Regarding the Average Index Numbers. The average of the November, December, and January BLS index numbers gives an actual average index number at 15 December 1975. An assumption was made that the 15 December 1975 index number would be representative of the 1 January 1976 index number. This assumption was necessary because a three month average of the index numbers was preferred to a two month average and because actual index numbers were not published for February at the time calculations were made. Thus, an actual three month index number could not be calculated at exactly 1 January 1976.

Predicting Future Index Numbers

The predictions of the rate of increase in aerospace prices were obtained from the ASD Cost Escalation Report (No. 110-C). The predicted "development" index numbers for airframe, engine, and avionics were used since Contract D is for development effort. As previously mentioned the airframe, engine, and avionics indexes are composite indexes and therefore each index reflects the projected increase in contract prices for labor, material, and overhead. Since a composite index is used to predict the rate of increase in contract prices, the predicted rate of increase in the labor and material indexes used in this report are the same.

The percentages of contract costs that are airframe, engine, and avionics oriented were obtained from the program finance office for each of the remaining fiscal years on the contract. This was done so that the predicted airframe, engine, and avionics indexes could be weighted properly to arrive at a composite index for use on the contract. Table VI shows the predicted indexes and contract percentages used to arrive at the composite contract index.

TABLE VI

Prediction of Composite Contract Index

FY	110 C Indexes			Contract Weights (%)			Composite Ind.
	A/F	Eng.	Avion.	A/F	Eng.	Avion.	Contract
75	100.00	100.00	100.00	65.0	16.2	18.8	100.000
76	108.10	110.00	106.90	54.7	18.6	26.7	108.133
7T	112.90	114.70	111.50	67.2	6.8	26.0	112.658
77	118.10	119.80	116.40	73.4	3.6	23.0	117.770
78	127.10	129.00	124.90	62.9	7.9	29.2	126.608
79	137.00	139.20	134.40	53.2	12.6	34.2	136.363
80	147.40	149.40	144.20	----	----	100.00	144.200

(Refs 9 and 19)

Determining the Actual Index Numbers at the Midpoint of the Adjusted Period

Table VI shows the composite contract index numbers for the midpoint of the indicated fiscal years (note that the three month adjustment to the fiscal year cycle is incorporated). However, as shown in Figure 4, the fiscal year midpoints do not in all cases correspond to the midpoint index numbers needed to make economic price adjustments. Four calculations were performed, when necessary, to determine

the actual index numbers for adjustment. Figure 4 helps explain these calculations.

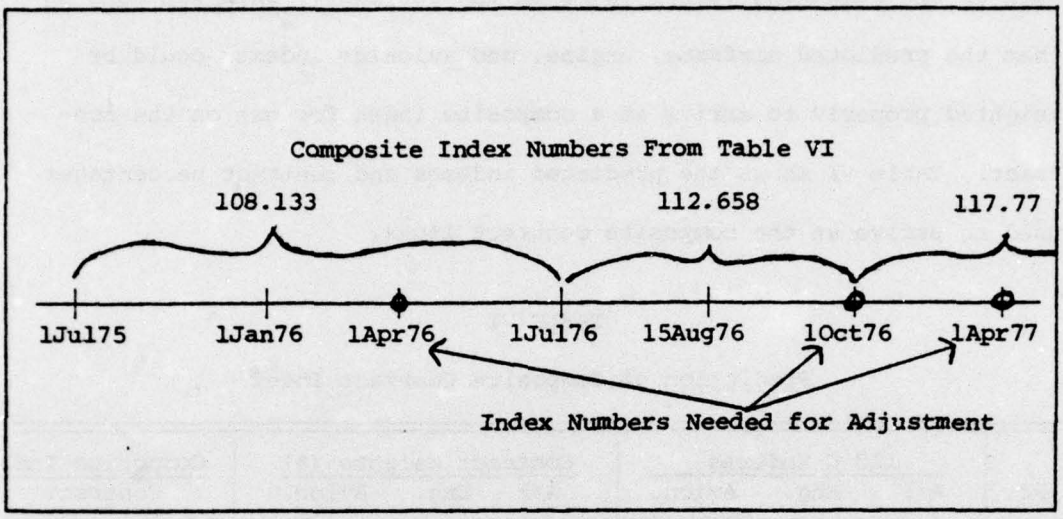


Fig. 4. Time Phased Index Numbers

Since adjustments had been made up to January 1, 1976, only the midpoint index numbers for the remaining seven adjustment periods needed to be calculated (as shown by the circles for adjustments 3, 4, and 5). For the third adjustment, the percentage change in the composite index number from 1 January 1976 to 15 August 1976 was calculated because the 1 January 1976 and 15 August 1976 index numbers were known and the index number needed for adjustment falls between these two index numbers. The calculation was performed by taking the ratio of 112.658 to 108.133 which equals 1.042. This indicates that the index increased by 4.2% over the seven and one-half month period. To determine the increase each month, which was assumed to be at a constant rate, the radical of 1.042 to the 7.5th root was calculated which equalled 1.0055. The 1.0055 was then cubed to arrive at the

percentage increase in the composite index number on 1 April 1976 which corresponds to the midpoint of the adjustment period. The percentage increase at the end of the third month was 1.6%. Multiplying 1.016 times the 108.133 gave the index number 109.9 on 1 April 1976.

This same process was followed to determine the midpoint index numbers for the remaining adjustments. However, the beginning (B) and ending (E) index numbers, the root number, and the power number were changed to cover the proper adjustment time period. In some cases calculations did not have to be made because the composite index number was at the midpoint of the adjustment period (as indicated in Figure 4 for the 117.77 index number). Table VII shows the composite index numbers for the remaining adjustments.

TABLE VII

Composite Index Numbers (CIN) for Remaining Adjustments

Adj. Time Period	$^{1}\frac{\text{(B) Index}}{\text{(E) Index}} = X$	$^{2}\sqrt[N]{X}=Y$	$^{3}(Y)^{M}=Z$	^{4} CIN (Z) X (B) Index
3	1.042	1.0055	1.016	109.9
4	1.045	1.0059	1.009	113.7
5				117.8
6	1.075	1.0060	1.036	122.1
7				126.6
8	1.077	1.0062	1.038	131.4
9				136.4

Change in Index from New Base

The change in the composite index from the 1 January 1976 base was determined by dividing the composite index numbers as shown in Table VII by the composite index number on 1 January 1976. These calculations are shown in Table VIII.

TABLE VIII

Change in Index from New Base

Midpoint of Adj. Time Period	[1] CIN	[2] CIN - 1 JAN 76	[3] CIN/CIN-1 JAN 76
1 APR 76	109.9	108.1	1.017
1 OCT 76	113.7	108.1	1.052
1 APR 77	117.8	108.1	1.090
1 OCT 77	122.1	108.1	1.130
1 APR 78	126.6	108.1	1.171
1 OCT 78	131.4	108.1	1.216
1 APR 79	136.4	108.1	1.262

The index numbers in column three predict that the increase in prices from the new base period will change from 1.7% for adjustment number three to 26.2% for adjustment number nine.

The Predicted Actual Index

The final step in predicting the actual index for use on future adjustments requires the multiplication of the change factor from Table VIII column three times the new base index numbers obtained in step one. These calculations are shown in Table IX. The index numbers

TABLE IX

Derivation of the Predicted Actual Index Numbers

Adj. Period	[1] Category	[2] New Base Indexes	X	[3] CIN / CIN-1JAN76	=	[4] Pred. Act. Indexes
3rd	Labor	117.0	X	1.017	=	118.99
	Material	120.7	X	1.017	=	122.75
4th	Labor	117.0	X	1.052	=	123.08
	Material	120.7	X	1.052	=	126.48
5th	Labor	117.0	X	1.090	=	127.53
	Material	120.7	X	1.090	=	131.56
6th	Labor	117.0	X	1.130	=	132.21
	Material	120.7	X	1.130	=	136.39
7th	Labor	117.0	X	1.171	=	137.01
	Material	120.7	X	1.171	=	141.34
8th	Labor	117.0	X	1.216	=	142.27
	Material	120.7	X	1.216	=	146.77
9th	Labor	117.0	X	1.262	=	147.65
	Material	120.7	X	1.262	=	152.32

shown in column four are used in the Contract A adjustment formula to predict the impact of abnormal inflation on contract prices.

Calculating the Remaining Adjustments

Table X provides the information used in the adjustment formula to determine the projected total dollar amount of adjustment on Contract A. Columns four and eight indicate the dollar amount of adjustment for labor and material respectively for each of the nine adjustment periods. Column nine is the summation of columns four and eight. The contract ceiling, price, and cost would be adjusted upward as a result of abnormal inflation by $21,771,278 (as shown at the bottom of column nine).

Impact of Profit Earned and the Coming-out Profit Rate

The contractor's target profit was $37,057,980. The profit the contractor earns after adjustments have been made is also $37,057,980. The profit earned is the same as the target profit for two reasons. The first reason is that the EPA provision regarding cost incentive type contracts states that when a contract contains cost incentives, a contractor will not be penalized for sums paid to him as a result of the EPA clause. Thus, although the contract target cost increased by $21,771,278 as a result of abnormally high inflation, the contractor does not absorb any of these costs.

The second reason the target profit does not change is that profit was not included in the dollar amount of contract price subject to adjustment. Thus, while the contract costs increased by $21,771,278

TABLE X

Calculations of the Remaining Adjustments

	Labor				Material				
Adj. Per.	[1]Predicted Actual Index	[2]Proj. Index	[3]Expnd. Profile	[4]Adjmt.	[5]Predicted Annual Index	[6]Proj. Index	[7]Expnd. Profile	[8]Adjmt.	[9]Total Adjmt.
1	109.48*	108.23	$12,123K	$ 140,014**	111.96*	106.73	$ 2,952K	$ 144,654**	$ 284,668**
2	114.82*	112.20	27,798K	649,115**	118.19*	110.40	11,398K	804,261**	1,453,376**
3	118.99	114.63	35,703K	1,357,979	122.75	113.23	17,652K	1,484,121	2,842,100
4	123.08	116.95	54,824K	2,873,630	126.98	115.95	31,577K	3,003,832	5,877,462
5	127.53	119.16	60,159K	4,225,670	131.56	118.57	18,682K	2,046,717	6,272,387
6	132.21	121.96	38,725K	3,254,602	136.39	121.93	1,963K	232,797	3,487,399
7	137.01	125.37	11,748K	1,090,745	141.34	125.91	388K	47,549	1,138,294
8	142.27	128.91	3,237K	339,208				$7,763,931	339,208
9	147.65	132.58	672K	76,384					76,384
				$14,007,347					$21,771,278

*Actual Index numbers.
**Actual adjustment value.

due to abnormally high inflation, the contractor receives no profit on the increased costs. Had profit been included in the dollar amount of contract price subject to adjustment, the contractor would have earned a greater amount of profit.

The impact of inflating cost but not profit for increases in contract prices resulting from abnormally high inflation is reflected by the coming-out profit rate. The coming-out profit rate is 10.33% while the going-in profit rate was 11%. The target cost increased by $21,771,278, the amount of adjustment, from $336,890,826 to $358,662,104 while the target profit remained the same, $37,057,980. The .67% reduction reflected by the coming-out profit rate represents a 6.09% decrease in the going-in profit rate of 11%.

Results of Quantitative Computations Performed on Contracts A, B, and C

The results of the quantitative computations performed on Contracts A, B, C, and D are presented in Table XI. The chart is divided into two sections. Section one relates contract cost and profit data before any economic price adjustments are made. Section two portrays the impact on contract cost and profit at the completion of the contracts resulting from applying the economic price adjustment clause in existence on each of the contracts. The calculations supporting the data in Table XI for Contracts A, B, and C are included in Appendices A, B, and C respectively. A summary of the results of the quantitative computations performed on Contracts A, B, and C follows.

TABLE XI

Results of Quantitative Computations

Contract Data Prior to Adjustments	Contract A	Contract B	Contract C	Contract D
Type of Contract	FPIF	FPIF	FFP	FPIF
Target Price or Contract Price	$146,030,505	$ 30,340,000	$ 93,557,000	$373,948,806
Target Cost or Contract Cost	132,771,487	27,210,000	84,557,000	336,890,826
Dollar Amount Subject to EPA	126,696,000	27,000,000	84,000,000	329,637,000
Target Profit	13,259,018	3,130,000	9,271,414	37,057,980
Going-In Profit Rate	10%	11.5%	11%	11%
Contract Data After Adjustments (Following Contractual EPA Provisions)				
Dollar Amount of Adjustment	$ 28,896,284	$ 4,664,201	$ 17,964,180	$ 21,771,278
Cost Increase	28,896,284	4,298,804	17,108,743	21,771,278
Profit Increase	---	365,397	855,437	---
Contract Costs Incurred	164,201,691	31,508,804	101,367,329	358,662,104
Profit Earned	12,498,842	3,495,397	10,126,851	37,057,980
Coming-Out Profit Rate	7.65%	11.09%	9.99%	10.33%

Contract A

Contract A uses the partial abnormal method of adjustment. The upper and lower band index numbers were established by increasing and decreasing the projected index numbers by 2% of their projected values. The dollar amount subject to economic price adjustment is $126,696,000, which does not include profit dollars. The dollar amount of adjustment during the life of the contract for abnormally high inflation is $28,896,284. However, costs are also incurred due to the abnormally high inflation occurring between the upper band index numbers and the projected index numbers and these costs are not adjusted. They are shared by the government and the contractor in accordance with the government/contractor share ratio (70/30; government's share/contractor's share).

The total cost incurred between the upper band index numbers and the projected index numbers is $2,533,920. The government absorbed $1,773,744 of these costs and the contractor $760,176. The contract costs incurred figure of $164,201,641 reflects the summation of target costs ($132,771,487), the dollar amount of adjustment ($28,896,284), and the costs incurred within the band ($2,533,920). As a result of the inflationary costs absorbed by the contractor within the band, the profit earned on the contract is $760,176 below the target profit. Thus, the profit earned on the contract is $12,498,842. To determine the coming-out profit rate, the profit earned is divided by the summation of target costs ($132,771,487), the dollar amount of adjustment ($28,896,284), and the costs absorbed by the government within the band ($1,773,744). The coming-out profit rate is 7.65%. The 2.35% reduction reflected by the coming-out profit rate represents a 23.5% decrease in

the going-in profit rate of 10%. The reduction is caused both by not reimbursing the contractor for all abnormally high inflationary costs incurred and by not including profit in the dollar amount of contract price subject to adjustment.

Contract B

Contract B uses the constant dollar method of adjustment. The target profit of $3,130,000 (as well as target costs, $27,210,000) is priced in first quarter 1975 dollars (just prior to contract award). The dollar amount subject to economic price adjustment is $27,000,000, which does not include profit dollars. However, the adjustment formula includes a factor for adjusting profit. When the dollar amount of adjustment for labor and material costs for an adjustment period is determined, the dollar amount is multiplied by 1.085. The difference between the adjustment for labor and material and the adjustment multiplied by the profit factor is the adjustment for profit. The 1.085 profit factor was determined during contract negotiations. It is included in the adjustment formula because the $3,130,000 profit figure does not include profit dollars on even normal escalation costs, and full profit has always been allowed in prior years on normal escalation costs. (Refs 4 and 7).

Following contract economic price adjustment provisions, the total dollar amount of adjustment on Contract B is $4,644,201. The adjustment for cost is $4,298,804. The adjustment for profit is $365,397. Thus, the profit earned is $3,495,397. The coming-out profit rate is determined by dividing the profit earned by the summation of target cost ($27,210,000) and the adjustment for cost ($4,298,804). This

calculation yields a coming-out profit rate of 11.09%. The .41% reduction reflected by the coming-out profit rate represents a 3.56% decrease in the going-in profit rate of 11.5%.

While the profit earned on the contract is greater than the target profit, the increase from the target profit was only to compensate the contractor for the impact of normal inflation on contract profit. Hence, the coming-out profit rate was still lower than the going-in profit rate since costs were adjusted for both normal and abnormally high inflationary impacts while profit was only adjusted for normal inflationary impacts.

Contract C

Contract C is a firm fixed-price contract. The data presented in section one of Table XI was obtained from the program's Price Negotiation Memorandum.

Like Contract B, Contract C uses a constant dollar method of adjustment. The dollar amount subject to economic price adjustment is $84,000,000, which includes $4,000,000 profit. Some profit was included in the dollar amount of contract price subject to adjustment, because the contract was priced in first quarter 1974 dollars and thus profit dollars on even normal inflationary costs were excluded.

The dollar amount of adjustment on Contract C is $17,964,180. This figure includes $17,108,743 for cost adjustments and $855,437 for profit adjustments. The profit earned is $10,126,851. The coming-out profit rate is determined by dividing the profit earned by the summation of contract cost ($84,285,586) and the adjustment for cost ($17,108,743). The coming-out profit rate is 9.99%. The 1.01%

reduction reflected by the coming-out profit rate represents a 9.18% decrease in the going-in profit rate of 11%.

As with Contract B, the profit earned on Contract C is greater than the target profit. This was because some profit was subject to economic price adjustment in order to reimburse the contractor for the impact of normal inflation on contract profit. However, since profit was only escalated for the effects of normal inflation, while cost was escalated for the effects of both normal and abnormally high inflation, the coming-out profit rate is lower than the going-in profit rate.

Summary

The purpose of this chapter was to predict the effect of economic price adjustment clauses currently in use on four fixed-price type contracts on the profit earned and the profit rates realized on the contracts. This objective was accomplished by performing a series of quantitative computations which were presented in this chapter and in supporting appendices to this study.

The effect of the EPA clauses on the profit earned on each of the contracts varied. The variances were caused by differences in the methods of adjustment used on the contracts. The partial abnormal method of adjustment was used on Contract A and the profit earned was $760,176 below the target profit. The $760,176 was the contractor's share of the abnormal inflationary costs occurring within the 2% upper band index numbers and the projected index numbers. The constant dollar method of adjustment was used on Contracts B and C and the profit earned increased from their corresponding target profits by $365,397 and $855,437 respectively. However, these increases to the

target profits were only to compensate the contractor for the effects of normal inflation on contract profit. This was necessary since the target profit on each of the contracts was priced in constant year dollars prior to contract award. The total abnormal method of adjustment was used on Contract D and the profit earned was the same as the target profit. The profit earned did not increase, as with the constant dollar method of adjustment, because the target profit already included compensation for the effect of normal inflation on contract profit. On the other hand, the profit earned did not decrease, as with the partial abnormal method of adjustment, because adjustments were made for all abnormal inflationary costs.

The coming-out profit rate was lower than the going-in profit rate on all four of the contracts. This was because costs were escalated for the effects of both normal and abnormally high inflation while profit was only escalated for the effects of normal inflation. The percentage decreases in the going-in profit rates on Contracts A, B, C, and D were 23.5%, 3.56%, 9.18%, and 6.09% respectively. The percentage decrease in Contract A's going-in profit rate reflects not only the effect of not escalating profit to compensate for the impact of abnormally high inflation on profit but also the effect of sharing some of the abnormally high inflationary costs.

CHAPTER V

COMPARATIVE ANALYSIS

Introduction

In Chapter Four the effect of the contractual EPA clauses on the profit earned and the profit rates realized was presented. In this chapter, hypothetical economic price adjustment clauses are developed by varying selected provisions of the contractual EPA clauses. The provisions varied are: the dollar amount of contract price subject to adjustment, the width of the band percentage, and the government/contractor share ratio.

The effect of the hypothetical EPA clauses on profit earned and the profit rates realized is presented. For each of the provisions varied, a comparative analysis of the profit earned and the profit rates realized while following the contractual and hypothetical EPA clauses is performed. Also, the profit earned and the profit rates realized while varying each of the three selected provisions are compared with each other. Relationships evolving from the comparative analysis are established. The changes made to the provisions varied are discussed below.

Fully Escalating Profit

As mentioned in Chapter Four, profit was not escalated on any of the four contracts to compensate for the effects of abnormal inflation on contract profit. Had profit been included in the dollar amount of

contract price subject to adjustment, the contractor would have earned a greater amount of profit. In order to calculate this increased profit amount the following assumptions were made:

1) The same percentage of profit is subject to adjustment as the percentage of cost subject to adjustment (total cost dollars subject to EPA ÷ target costs).

2. The same percentage of profit is included in the labor and material expenditure profiles during the adjustment time periods as the percentage of costs included in the profiles during the adjustment time periods.

An example will help clarify these assumptions.

Table XII shows Contract D cost and profit data. The total costs subject to EPA represent 97.85% of the target costs. Thus, in accordance with assumption number one, $36,261,233 (.9785 X $37,057,980) of the target profit is subject to adjustment. During adjustment period number five, the labor costs subject to adjustment are $60,159,000. These costs represent 18.25% of the total costs subject to EPA. Thus, in accordance with assumption number two, $6,617,675 (.1825 X $36,261,233) of the profit subject to adjustment is also included in the labor expenditure profile during the fifth adjustment period. Hence, the dollar amount of labor subject to adjustment during the fifth adjustment period increases to $66,776,461. The remaining profit was allocated to the relevant labor and material expenditure profiles in the same manner before the five step quantitative computational process was begun. By varying only the dollar amount of contract price subject to adjustment, the effect of including profit

in the dollar amount subject to adjustment on profit earned and the coming-out profit rates is isolated.

TABLE XII

Contract D Cost and Profit Data

Target Cost	$336,890,826
Total Costs Subject to EPA	329,637,000
Target Profit	37,057,980
Labor Costs Subject to EPA (Adjustment Period #5)	60,159,000

Varying the Width of the Band Percentage

Of the four contracts selected for inclusion in this study, only Contract A uses a band (2%) to share the costs of abnormal inflation. In order to determine how varying the width of the band percentage affects the profit earned and the coming-out profit rates, Contract A is analyzed both without the 2% band (using the total abnormal method of adjustment) and with a 4% band. Also, Contract D, which does not use a band, is analyzed both with a 2% band and a 4% band. Band analysis is not performed on Contracts B and C because they use the constant dollar method of adjustment and therefore projected indexes were not developed for use in the adjustment formula. By varying only the width of the band percentage, the effect of changing the band width on profit earned and the coming-out profit rate is isolated.

Varying the Government/Contractor Share Ratio

When bands are used, the abnormal inflationary costs occurring within the bands are shared in accordance with the government/contractor

share ratio. The share ratios for Contracts A and D are 70/30 and 90/10 respectively. For this analysis, bands of 2% and 4% are used and the effect of using share ratios of 70/30, 80/20 and 90/10 are determined for Contracts A and D. The effect of varying the share ratio on the profit earned and the profit rates realized is isolated within each of the band widths utilized.

Results of Fully Escalating Profit

The results of the quantitative computations performed on Contracts A, B, C, and D, when profit was fully escalated, are presented in Table XIII. The top two sections of the chart were previously discussed in Chapter Four. Section one presents cost and profit data before any economic price adjustments are made. Section two portrays the impact on contract cost and profit at the completion of the contracts resulting from applying the economic price adjustment provisions in existence on each of the contracts.

Section three shows the effects on contract cost and profit following the contractual EPA provisions except for fully escalating profit in accordance with the assumptions previously discussed in this chapter. These assumptions were that the same percentage of profit is subject to EPA as the percentage of cost subject to EPA and that the same percentage of profit is included in the labor and material expenditure profiles during the adjustment time periods as the percentage of costs included in the profiles during the adjustment time periods. Following these assumptions, profit was escalated for the effects of abnormal inflation in the same manner as costs.

TABLE XIII

Results of Quantitative Computations (Including Profit Fully Escalated)

Contract Data Prior to Adjustments	Contract A	Contract B	Contract C	Contract D
Type of Contract	FPIF	FPIF	FFP	FPIF
Target Price or Contract Price	$146,030,505	$30,340,000	$ 93,557,000	$373,948,806
Target Cost or Contract Cost	132,771,487	27,210,000	84,557,000	336,890,826
Dollar Amount Subject to EPA	126,696,000	27,000,000	84,000,000	329,637,000
Target Profit	13,259,018	3,130,000	9,271,414	37,057,980
Going-In Profit Rate	10%	11.5%	11%	11%
Contract Data After Adjustments (Following Contractual EPA Provisions)				
Dollar Amount of Adjustment	$ 28,896,284	$ 4,664,201	$ 17,964,180	$ 21,771,278
Cost Increase	28,896,284	4,298,804	17,108,743	21,771,278
Profit Increase	---	365,397	855,437	---
Contract Costs Incurred	164,201,691	31,508,804	101,367,329	358,662,104
Profit Earned	12,498,842	3,495,397	10,126,851	37,057,980
Coming-Out Profit Rate	7.65%	11.09%	9.99%	10.33%
Contract Data After Adjustments (Profit Fully Escalated)				
Dollar Amount of Adjustment	$ 31,770,683	$ 4,792,316	$ 18,987,735	$ 24,166,118
Profit Earned - Fully Escalated	15,449,136	3,623,512	11,150,406	39,452,820
Increase in Profit Earned	2,950,294	128,115	1,023,555	2,394,840
Coming-Out Profit Rate	9.45%	11.5%	11%	11%

Contract A

On Contract A the dollar amount of adjustment increased to $31,770,683 which is $2,874,399 more than the adjustment provided by following the contractual EPA provisions. The $2,874,399 increase in the dollar amount of adjustment is less than the increase in the profit earned of $2,950,294 because the profit earned also included $75,895 which was paid to the contractor for the impacts of abnormal inflation on profit occurring within the 2% contract band. The 9.45% coming-out profit rate did not increase to the 10% going-in profit rate because the cost and profit falling within the 2% contract band were shared in accordance with the 70/30 government/contractor share ratio.

Contracts B, C, and D

On Contracts B, C, and D the dollar amount of adjustment increased by $128,115, $1,023,555, and $2,394,840 respectively. The increases in the dollar amount of adjustment are the same as the increases in the profit earned on each of the contracts since bands were not used on any of the contracts. The coming-out profit rates on each of the contracts returned to their going-in profit rate percentages, because the profit and costs were escalated in the same manner to compensate for the effects of abnormal inflation and because bands were not used on any of the contracts.

Results of Varying the Width of the Band Percentage

Quantitative computations were also performed on Contracts A and D to determine the effect of varying the width of the band percentage on profit earned and the coming-out profit rates. The results of the

quantitative computations are shown in Table XIV. Table XIV is divided into three sections. Section one shows the differences between the profit earned and the coming-out profit rates when 0% and 2% bands were used; section two, the differences when 2% and 4% bands were used; and section three, the differences when 0% and 4% bands were used.

Contract A

As shown in section one, when a 2% band is used on Contract A, the profit earned falls by $760,176. Section two shows that the reduction in the profit earned when the bands were changed from 2% to 4% is also $760,176. As would be expected with knowledge of the above results, section three shows that doubling the band width doubled the amount of profit lost on this contract. The differences in the coming-out profit rates, however, indicate slightly different results. Doubling the band width more than doubles the percentage decrease in the coming-out profit rate (.85% in lieu of .84%).

An Explanation of the Results Obtained (Profit Earned). The reason the profit lost doubles when the band width doubles is that for each of the adjustment time periods the labor and material actual index numbers for Contract A are "always" greater than the labor and material 4% upper band index numbers. Since the labor and material actual index numbers were always greater than their respective 4% upper band index numbers, the following formula was used to determine the dollar amount of abnormal inflationary costs falling within the bands:

((UB Index - Proj. Index)/Proj. Index) X Proj. Costs) (7)

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TABLE XIV

The Effect of Bands on Profit Earned and Coming-Out Profit Rates

Differences Between 0% - 2% Bands	Contract A	Contract D
Profit Earned - 0% Band	$13,259,018	$37,057,980*
Profit Earned - 2% Band	$12,498,842*	$36,408,951
Difference in Profit Earned	$760,176	$649,029
Coming-out Profit Rate - 0% Band	8.07%	10.33%*
Coming-out Profit Rate - 2% Band	7.65%*	10.17%
Difference in Profit Rates	.42%	.16%
Differences Between 2% - 4% Bands		
Profit Earned - 2% Band	$12,498,482*	$36,408,951
Profit Earned - 4% Band	$11,738,666	$35,827,218
Difference in Profit Earned	$760,176	$581,733
Coming-out Profit Rate - 2% Band	7.65%*	10.17%
Coming-out Profit Rate - 4% Band	7.22%	10.02%
Difference in Profit Rates	.43%	.15%
Difference Between 0% - 4% Bands		
Profit Earned - 0% Band	$13,259,018	$37,057,980*
Profit Earned - 4% Band	$11,738,666	$35,827,218
Difference in Profit Earned	$1,520,352	$1,230,762
Coming-out Profit Rate - 0% Band	8.07%	10.33%*
Coming-out Profit Rate - 4% Band	7.22	10.02%
Difference in Profit Rates	.85%	.31%

*Profit earned and profit rates realized while following the contractual EPA clause.

This formula was applied using the labor and material indexes and expenditure profiles for each of the adjustment time periods. When performing these calculations the first part of the formula ((UB Index - Projected Index)/Projected Index) always reduced to .02 or .04 when bands of 2% and 4% were used, since the upper band index numbers were established two and four percent above the projected index numbers. Thus, on this contract the dollar amount of abnormal inflationary costs falling within the bands when a 4% band is used is twice as much as when a 2% band is used. Furthermore, the dollar amount of abnormal inflationary costs falling within the band due to changing from not using a band to using a 2% band is the same as the dollar amount of abnormal inflationary costs falling within the band due to changing from a 2% band to a 4% band. The differences in the profit earned (shown in Table XIV) indicate the contractor's share of the dollar amount of abnormal inflationary costs falling within the band.

An Explanation of the Results Obtained (Coming-Out Profit Rates). The effect of varying the width of the band percentage on the coming-out profit rates was determined by dividing the profit earned on the contract by the reimbursable contract cost. The profit earned was calculated by subtracting the contractor's share of in-band costs from target profit. The reimbursable contract cost was calculated by summing the target cost, the adjustment for cost above the band, and the government's share of in-band cost.

When a 2% band was used, both the target profit and the reimbursable contract cost decreased by $760,176. This decrease caused the coming-out profit rate to fall from 8.07% to 7.65%. When a 4%

band was used, the target profit and the reimbursable contract cost each decreased by $1,520,352 (2 X $760,176), which caused the coming-out profit rate to fall from 8.07% to 7.22%. The reduction in the coming-out profit rate when a 4% band was used (.85%) was slightly more than double the reduction in the coming-out profit rate when a 2% band was used (.42%). The reason for the .01% difference is that the additional $760,176 decrease in the target profit and the reimbursable contract cost (between the 2% and 4% bands) was subtracted from target profit and reimbursable contract cost figures which had already been decreased by $760,176 (due to the effect of the 2% band). The mathematical law of proportions which causes the profit rate to decrease at an increasing rate as like dollar amounts are continuously subtracted from the original profit and cost figures generally only slightly affects the coming-out profit rate and usually does not change the relationship obtained between varying the band width and the difference in the profit earned and varying the band width and the difference in the coming-out profit rate. However, the effect of the mathematical law of proportions is evident on Contract A since varying the band width from 2% to 4% exactly doubles the amount of profit lost but more than doubles the reduction in the coming-out profit rate.

Contract D

The profit earned when using a 2% band on Contract D is $649,029 less than the profit earned when a band is not used. The difference in the profit earned when a 4% band is used instead of a 2% band is $581,733. On Contract D the amount of profit lost when using a

4% band is less than double the amount of profit lost when using a 2% band.

Varying the width of the band percentage inversely affects both the coming-out profit rate and the profit earned. As the band width increases from 2% to 4%, the coming-out profit rate decreases, although this doubling of the band width does not double the reduction in the coming-out profit rate.

For Contract D emphasis is placed on analyzing the effect of varying the width of the band percentage on profit earned. The reduction in the profit earned (profit lost) when band widths are widened is the contractor's share of increased costs falling within the band. In determining the coming-out profit rate when bands are widened, the contractor's share of increased cost is subtracted from both the contractor's profit and the reimbursable contract cost because the government's savings in reimbursable costs is the contractor's loss in profit earned. Thus, a greater understanding of the effect of varying the width of the band percentage on profit earned also increases one's understanding of the effect of varying the width of the band percentage on the coming-out profit rate.

The reason the profit lost when a 4% band is used is less than double the amount of profit lost when a 2% band is used is that for each of the adjustment time periods the labor and material actual index numbers for Contract D are not always greater than the 4% upper band (UB) index numbers. Figure 5 helps explain how the abnormal inflationary costs are shared when the actual index numbers are higher than the projected index numbers and the bands are varied from two to four percent. As shown in Figure 5, when the actual index numbers are

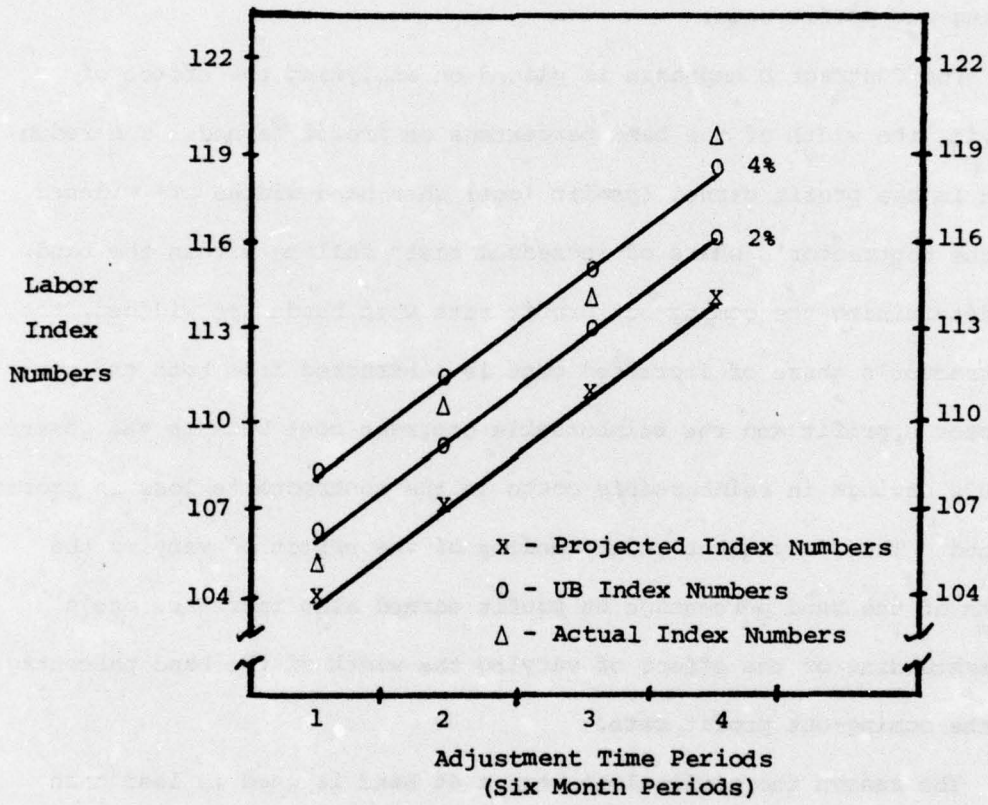

Fig 5. Labor Index Number Trends

higher than the projected index numbers, the actual index number must fall in one of three areas: 1) within the 2% band, 2) within the 2% and 4% bands, or 3) above the 4% band. While only labor index number trends are shown in Fig. 5, the abnormal inflationary costs would be shared in the same manner for material costs when the material actual index numbers fall in the three areas mentioned above.

Actual Index Number Within the 2% Band. When the actual index number falls within the 2% band, as shown in adjustment period number one, the abnormal inflationary cost increase in the labor expenditure profile for the first adjustment period is determined by dividing the difference between the actual and projected index numbers by the projected index number and multiplying the resultant quotient by the labor expenditure profile for the first adjustment period. This cost increase is less than 2% of the expenditure profile dollar amount for the first adjustment period, since the actual labor index is less than the 2% upper band index number. The profit lost during the first adjustment period is the contractor's share of the abnormal inflationary cost increase. The profit lost is the same with a 4% band as with a 2% band, since the actual index number is within the 2% band. In general, if the bands on a contract are widened to the point where all labor and material actual index numbers fall within their respective labor and material upper band index numbers, further increases in the width of the band percentage will not have any effect on the profit earned on the contract.

Actual Index Numbers Within the 2% and 4% Bands. When the actual index number is between the 2% and 4% bands, as shown in adjustment periods two and three, and a 4% band is used, the abnormal inflationary

cost increase in the labor expenditure profile for each adjustment time period is determined by dividing the difference between the actual and projected index numbers by the projected index number and multiplying the resultant quotient by the labor expenditure profile for the adjustment time period. However, when a 2% band is used, the above formula is modified. The abnormal inflationary cost increase in the labor expenditure profile for each adjustment time period is determined by dividing the difference between the "2% upper band index number and the projected index number" by the projected index number and multiplying the resultant quotient by the labor expenditure profile for the adjustment time period.

With a 2% band the abnormal inflationary cost increase within the band is exactly 2% of the expenditure profile dollar amount for the adjustment period, since the upper band index is 2% above the projected index number. The profit lost during the adjustment period is the contractor's share of the abnormal inflationary cost increase. However, profit is not lost above the band because the contractor receives a full adjustment for abnormal inflationary cost increases above the band.

When a 4% band is used instead of a 2% band, the profit lost during the adjustment period increases, because the contractor is no longer receiving a full adjustment for abnormal inflationary cost increases above the 2% band. These cost increases fall within the 4% band and are therefore shared by the government and the contractor. Although the width of the band percentage was doubled from 2% to 4%, the amount of profit lost does not double, since the actual index number is less than the 4% upper band index number.

Actual Index Numbers Above the 4% Band. When the actual index number is above the 4% band index number, as shown in adjustment period four, the profit lost during the adjustment period when a 4% band is used is double the profit lost when a 2% band is used. Under both band conditions the adjustment for abnormal inflationary cost increases is the same above the 4% upper band index number and between the projected index number and the 2% upper band index number. However, when a 2% band is used, the contractor receives an adjustment for abnormal inflationary cost increases within the 2% and 4% bands; whereas, when a 4% band is used, the government and the contractor share the increased costs within the 2% and 4% bands. The profit the contractor loses as a result of sharing the increased costs between the 2% and 4% bands is exactly the same as the profit he loses sharing the increased costs between the projected index number and the 2% band. Hence, the profit lost during the adjustment period when a 4% band is used is double the profit lost when a 2% band is used. In general, when the bands are changed from 2% to 4% and all of the actual index numbers are above the 4% band, the profit lost on the contract will double (as was the case on Contract A). Indeed, the profit lost on a contract as a result of doubling the band width can never more than double.

Application to Contract D. On Contract D the profit lost did not double when the width of the band percentage was doubled because the actual labor index number was less than the 2% upper band labor index number during the first adjustment time period and was between the 2% and 4% upper band index numbers for the second and third adjustment time periods. Thus, during the first adjustment time period, the

profit lost was the same when 2% and 4% bands were used. During the second and third adjustment time periods, the profit lost was greater when a 4% band was used, but was less than double the profit lost when a 2% band was used. On Contract D the profit lost with a 4% band ($1,230,762) was nearly double the profit lost with a 2% band ($649,029) because the actual index numbers for the remaining six labor adjustment time periods and for all nine material adjustment time periods were greater than their respective 4% upper band index numbers.

Results of Varying the Share Ratio

In the context of this study, the share ratio only affects the profit earned and the profit rates realized when bands are used. Table XV shows the profit earned and the profit rates realized on Contracts A and D when bands are not used (0% band width). It also shows the profit earned and the profit rates realized when bands of 2% and 4% are used and the share ratio is varied (90/10, 80/20, 70/30) within both the 2% and 4% band widths. A comparative analysis of these results was performed using the 0% band width as the baseline.

Effects on Profit Earned

As shown in Table XV, the profit earned on each of the contracts decreased as the contractor's percentage share of the abnormal inflationary costs occurring within each of the bands increased. A comparative analysis of the results revealed that the profit lost was directly proportional to the increase in the contractor's percentage share of the abnormal inflationary costs occurring within a given band. For example, on Contract A (2% band) the profit lost when a 70/30 share

TABLE XV

The Effect of the Share Ratio on Profit Earned and the Coming-out Profit Rate

Band Width	Share Ratio	Contract A		Contract D	
		Profit Earned	Coming-out Profit Rate	Profit Earned	Coming-out Profit Rate
0%	---	$13,259,018	8.07%	$37,057,980*	10.33%*
2%	90/10	$13,005,626	7.93%	$36,408,951	10.17%
	80/20	$12,752,234	7.79%	$35,759,922	10.01%
	70/30	$12,498,842*	7.65%*	$35,110,893	9.84%
4%	90/10	$12,752,234	7.79%	$35,827,218	10.02%
	80/20	$12,245,450	7.50%	$34,596,456	9.71%
	70/30	$11,738,666	7.22%	$33,365,694	9.40%

*Indicates the profit earned and profit rates realized while following the contractual EPA clause.

ratio was used ($760,176) was three times the amount of profit lost when a 90/10 share ratio was used ($253,392).

Effects on Coming-out Profit Rates

Like the profit earned, the coming-out profit rates on each of the contracts decreased as the contractor's percentage share of abnormal inflationary costs occurring within the bands increased. However, the reduction in the coming-out profit rate was not exactly proportional to the increase in the contractor's percentage share of the abnormal inflationary costs occurring within the bands. For example, on Contract D (2% band) the reduction in the coming-out profit rate when a 70/30 share ratio was used (.49%) was slightly more than three times the reduction in the coming-out profit rate when a 90/10 share ratio was used (.16%). As previously discussed, comparisons between the coming-out profit rates are slightly affected by the mathematical law of proportions.

A Comparative Analysis of the Results Obtained While Varying Each of the Selected Provisions

Table XVI presents a summary of the profit earned and the profit rates realized on Contracts A and D while implementing the contractual and hypothetical EPA clauses included in this study. The contract target profit and going-in profit rate are also presented in row one of the table. With the data presented in Table XVI, the profit lost and the reduction in the profit rates realized resulting from not fully escalating profit and from using each of the six selected band/share ratio combinations was determined.

TABLE XVI

Summary of Results

Contract A	Profit Earned	Profit Rates Realized
1) Contract Targets	$13,259,018	10%
2) Contractual EPA Clause	12,498,842	7.65%
3) Profit Fully Escalated - 0% Band	15,525,041	10%
4) 0% Band	13,259,018	8.07%
5) 2% Band - 90/10 Share Ratio	13,005,626	7.93%
6) 4% Band - 90/10 Share Ratio	12,752,234	7.79%
7) 2% Band - 80/20 Share Ratio	12,752,234	7.79%
8) 4% Band - 80/20 Share Ratio	12,245,450	7.50%
9) 2% Band - 70/30 Share Ratio*	12,498,842	7.65%
10) 4% Band - 70/30 Share Ratio	11,738,666	7.22%

Contract D	Profit Earned	Profit Rates Realized
1) Contract Targets	$37,057,980	11%
2) Contractual EPA Clause	37,057,980	10.33%
3) Profit Fully Escalated - 0% Band	39,452,820	11%
4) 0% Band*	37,057,980	10.33%
5) 2% Band - 90/10 Share Ratio	36,408,951	10.17%
6) 4% Band - 90/10 Share Ratio	35,827,218	10.02%
7) 2% Band - 80/20 Share Ratio	35,759,922	10.01%
8) 4% Band - 80/20 Share Ratio	34,596,456	9.71%
9) 2% Band - 70/30 Share Ratio	35,110,893	9.84%
10) 4% Band - 70/30 Share Ratio	33,365,694	9.40%

*Same as Contractual EPA Clause

The profit lost due to not fully escalating profit was calculated by subtracting the profit earned when profit was not fully escalated and a 0% band was used (row 4) from the profit earned when profit was fully escalated and a 0% band was used (row 3). The profit lost due to using each of the six selected band/share ratio combinations was calculated by subtracting the profit earned as shown in rows five through ten from the profit earned as shown in row four. The same approach was followed to determine the reduction in the profit rates realized. A comparative analysis of the results was then performed to determine whether not fully escalating profit or using the selected band/share ratio combinations had a greater effect on profit earned and the profit rates realized.

A comparative analysis was also performed to determine whether increasing the contractor's share percentage by 10% or increasing the width of the band percentage by 2% had a greater effect on profit earned and the profit rates realized. The calculations made in support of the comparative analysis are presented in this study.

Not Fully Escalating Profit Versus
Band/Share Ratio Combinations

The contractor lost $2,266,023 profit on Contract A as a result of not escalating profit for the effects of abnormal inflation. This loss in profit reduced the profit rate realized when profit was fully escalated by 1.93% from 10% to 8.07%. When a 4% band was used with a 70/30 share ratio, the profit lost was $1,520,352, which reduced the already deflated profit rate of 8.07% by an additional .85%. As shown in Table XVI, when a 4% band width and a 70/30 share ratio were used, the profit earned and the profit rate realized were lower than those

obtained when each of the remaining five band/share ratio combinations were used. These results are in consonance with previous findings presented in this study. The profit earned and the profit rates realized decrease as the band width is widened. Also, the profit earned and the profit rates realized decrease as the contractor's percentage share of abnormal inflationary costs falling within the bands increases. On Contract A the profit lost and the reduction in the profit rate realized when profit was not fully escalated were greater than the profit lost and the reduction in the profit rate realized when the worst case of the six selected band/share ratio combinations was used. It thus follows that not fully escalating profit has a greater effect on the profit earned and the profit rate realized than using any one of the six selected band/share ratio combinations. The results obtained from the above comparative analysis were primarily influenced by the extent to which the actual index numbers exceeded the projected index numbers. On this contract the actual index numbers were high enough above the projected index numbers to cause the loss in profit due to not escalating profit for the effects of abnormal inflation to exceed the loss in profit due to using any one of the six band/share ratio combinations.

On Contract D the actual index numbers were not high enough above the projected index numbers to cause the loss in profit due to not escalating profit for the effects of abnormal inflation to exceed the loss in profit due to using any one of the six band/share ratio combinations. The contractor lost $2,394,840 on Contract D as a result of not escalating profit for the effects of abnormal inflation. This loss in profit reduced the going-in profit rate of 11% by .67%. The

profit lost when a 4% band was used with a 70/30 government/contractor share ratio was $3,692,286, which reduced the already deflated profit rate of 10.33% by an additional .93%. Thus, the effect of using a 4% band with a 70/30 share ratio on the profit earned and the profit rate realized was greater than the effect of not fully escalating profit for the impact of abnormal inflation. The profit lost when a 4% band was used with an 80/20 share ratio ($2,461,524) was also greater than the profit lost due to not fully escalating profit ($2,394,840); however, the reduction in the profit rate realized (.62%) was not as great as the reduction in the profit rate realized due to not fully escalating profit (.67%). For the remaining four band/share ratio combinations, not fully escalating profit did have a greater effect on the profit earned and the profit rates realized than the band/share ratio combinations.

In summary, for the contracts analyzed, not fully escalating profit usually had a greater effect on profit earned and the profit rates realized than did the various selected band/share ratio combinations. In general the chance of a band/share ratio combination having a greater effect on profit earned and the profit rate realized than not fully escalating profit increases as 1) the difference between the actual index numbers and their respective projected index numbers narrows and/or 2) the width of the band percentage widens and/or the contractor's share percentage increases.

Share Percentages Versus Band Width

Tables XVII and XVIII show the calculations made on Contracts A and D respectively to determine if increasing the contractor's share

TABLE XVII

Band Width versus Share Ratio (Effects on Profit--Contract A)

Share Ratio	90/10		Differences
Band Width	2%	4%	
Profit Earned	$13,005,626	$12,752,234	$253,392
Profit Rate Realized	7.93%	7.79%	.14%
Band Width	2%		
Share Ratio	90/10	80/20	
Profit Earned	$13,005,626	$12,752,234	$253,392
Profit Rate Realized	7.93%	7.79%	.14%
Share Ratio	80/20		Differences
Band Width	2%	4%	
Profit Earned	$12,752,234	$12,245,450	$506,784
Profit Rate Realized	7.79%	7.50%	.29%
Band Width	2%		
Share Ratio	80/20	70/30	
Profit Earned	$12,752,234	$12,498,842	$253,392
Profit Rate Realized	7.79%	7.65%	.15%

TABLE XVIII

Band Width versus Share Ratio (Effects on Profit--Contract D)

Share Ratio	90/10		Differences
Band Width	2%	4%	
Profit Earned	$36,408,951	$35,827,218	$581,733
Profit Rate Realized	10.17%	10.02%	.15%
Band Width	2%		
Share Ratio	90/10	80/20	
Profit Earned	$36,408,951	$35,759,922	$649,029
Profit Rate Realized	10.17%	10.01%	.16%
Share Ratio	80/20		Differences
Band Width	2%	4%	
Profit Earned	$35,759,922	$34,596,454	$1,163,437
Profit Rate Realized	10.01%	9.71%	.30%
Band Width	2%		
Share Ratio	80/20	70/30	
Profit Earned	$35,759,922	$35,110,893	$649,029
Profit Rate Realized	10.01%	9.84%	.17%

percentage by 10% had a greater effect on profit earned and the profit rates realized than increasing the width of the band percentage from 2% to 4%. In order to make this comparison, the share ratio was changed while the bands were held constant and vice versa. Comparisons were made starting from both a 90/10 share ratio and an 80/20 share ratio.

On Contract A, when starting from a 90/10 share ratio, the reduction in the profit earned and the profit rate realized due to increasing the contractor's share percentage to 20% was the same as the reduction in the profit earned and the profit rate realized due to increasing the width of the band percentage from 2% to 4%. The same decreases were obtained under both conditions, because on Contract A all of the actual index numbers were above the 4% upper band index numbers and both the contractor's share percentage and the band width percentage were increased by a factor of two. When starting from an 80/20 share formula, increasing the width of the band percentage from 2% to 4% reduced the profit earned and the profit rate realized more than increasing the contractor's share percentage to 30%. The decrease in the profit earned, when the band width was doubled, was 20% of the dollar amount of abnormal inflation occurring within the 2% and 4% bands; whereas, the decrease in the profit earned, when the contractor's share percentage was increased from 20% to 30%, was only 10% of the dollar amount of abnormal inflation occurring within the 2% band.

On Contract D, when starting from a 90/10 share ratio, the 10% increase in the contractor's share percentage reduced the profit earned and the profit rate realized more than increasing the width

of the band percentage from 2% to 4%. The share percentage had a greater effect on the profit earned and the profit rate realized, because on Contract D not all of the actual index numbers were above the 4% upper band index numbers. Thus, the dollar amount of abnormal inflation occurring within the 2% and the 4% bands was less than the dollar amount of abnormal inflation occurring within the 2% band. When starting from an 80/20 share ratio, increasing the width of the band percentage had a greater effect than increasing the contractor's share percentage to 30%. As was the case on Contract A, 20% of the dollar amount of abnormal inflation occurring within the 2% and 4% bands was greater than 10% of the dollar amount of abnormal inflation occurring within the 2% band.

Summary

In this chapter hypothetical EPA clauses were developed by varying selected provisions of the contractual EPA clauses. The effect of these hypothetical EPA clauses on contract profit earned and the profit rates realized was in turn presented. A comparative analysis of the profit earned and the profit rates realized while following the contractual and hypothetical EPA clauses was then performed in order to establish the relationships evolving from varying the selected provisions.

When profit was fully escalated, the profit earned was greater than both the target profit and the profit earned while following the contractual EPA clauses. Escalating the profit compensated the contractor for losses in the purchasing power of profit resulting from abnormal economic fluctuations. By adjusting both profit and cost,

the coming-out profit rates increased to their going-in profit rate objectives on three of the four contracts analyzed. On the fourth contract the coming-out profit rate increased, but it was below the going-in profit rate objective because a 2% band was used on the contract.

The profit earned and the profit rates realized decreased when bands were used. Furthermore, as the width of the band percentage was increased from 2% to 4%, the profit earned and the profit rates realized continued to decrease. The loss in the profit earned and the reduction in the profit rates realized, when a 4% band was used in lieu of a 2% band, were found to be a function of where the actual index numbers fell. On Contract A, all the actual index numbers were greater than the 4% upper band index numbers. Thus, when the width of the band percentage was doubled, the profit lost doubled and the reduction in the profit rate realized slightly more than doubled. On Contract D, some of the actual index numbers were between the projected index numbers and the 4% upper band index numbers. Hence, when a 4% band was used, the profit lost and the reduction in the profit rate realized was less than double the amount of profit lost and the reduction in the profit rate realized when a 2% band was used.

Regarding the government/contractor share ratio, as the contractor's share percentage increased, the profit earned and the profit rates realized decreased. Furthermore, the profit lost was directly proportional to the increase in the contractor's share percentage. For example, the dollar amount of profit lost when the contractor's share percentage was 30% was triple the dollar amount of profit lost when his share percentage was 10%.

When comparing the results obtained from varying the provisions, not fully escalating profit usually had a greater effect on profit earned and the profit rates realized than did the selected band/share ratio combinations. Also, when a 90/10 share ratio was used, increasing the contractor's share percentage to 20% caused the same or a greater reduction in the profit earned and the profit rates realized than did increasing the band percentage from 2% to 4%. However, when an 80/20 share ratio was used, increasing the width of the band percentage from 2% to 4% caused a greater reduction in the profit earned and the profit rates realized than did increasing the contractor's share percentage to 30%.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Economic price adjustment clauses are currently being used on major weapon system fixed-price type contracts to protect the contractor and the government against significant economic fluctuations in contract prices. The Armed Services Procurement Regulations provide "general guidelines" regarding the use of EPA clauses. Thus, there are many varieties of EPA clauses. They differ in the manner in which certain EPA provisions are implemented and in the methods of adjustment utilized.

Little research has been conducted regarding how EPA clauses are actually being implemented and what effects these clauses have on contract cost and profit. In this study quantitative computations were performed in order to predict the effect of EPA clauses currently in use on four fixed-price type contracts on the profit earned and the profit rates realized on these contracts. The profit earned and the profit rates realized while following the contractual EPA clauses were presented and discussed in Chapter Four. Hypothetical EPA clauses were then developed by varying selected provisions of the contractual EPA clauses. The provisions varied were: the dollar amount of contract price subject to adjustment, the width of the band percentage, and the government/contractor share ratio. The profit earned and the profit rates realized while following the various hypothetical EPA

clauses were computed and the results were presented in Chapter Five. For each of the provisions varied, a comparative analysis of the profit earned and the profit rates realized while following the contractual and hypothetical EPA clauses was performed. Also, the profit earned and the profit rates realized while varying each of the three selected provisions were compared with each other. Relationships evolving from the comparative analysis were established.

Applicability

The quantitative computations and comparative analysis performed in this study produced certain findings that have been summarized below. These findings apply to the contracts analyzed. However, many of the findings are also applicable to other fixed-price type contracts which experience abnormally high inflation and utilize EPA clauses similar to those used on the contracts included in this study.

Findings

The effect of the contractual EPA clauses on the profit earned varied on each of the contracts. The variances were caused by differences in the method of adjustment used on the contracts. When comparing the profit earned on each of the contracts to their target profits, the profit earned 1) decreased when the partial abnormal method of adjustment was used, 2) remained the same when the total abnormal method of adjustment was used, and 3) increased when the constant dollar method of adjustment was used.

The profit rates realized on each of the contracts while following the contractual EPA clauses were lower than their going-in profit rate objectives. The percentage decreases in the going-in profit rates

on Contracts A, B, C, and D were 23.5%, 3.56%, 9.18% and 6.09% respectively. The percentage decreases in the going-in profit rates on Contracts B, C, and D were caused by not escalating profit for the effects of abnormally high inflation. The percentage decrease on Contract A's going-in profit rate reflects both the effect of not escalating profit to compensate for the impact of abnormally high inflation on profit and the effect of sharing some of the abnormally high inflationary costs.

When profit was fully escalated, the profit earned was greater than both the target profit and the profit earned while following the contractual EPA clauses. The increase in the profit earned compensated the contractor for losses in the purchasing power of profit resulting from abnormal inflation. By adjusting both profit and cost, the profit rates realized increased to their going-in profit rate objectives on three of the four contracts analyzed. On Contract A the profit rate realized increased, but was still below the going-in profit rate objective because a 2% band was used on the contract.

The profit earned and the profit rates realized decreased when bands were used. Furthermore, as the width of the band percentage was increased from 2% to 4%, the profit earned and the profit rates realized continued to decrease. When a 4% band was used in lieu of a 2% band, the loss in the profit earned and the reduction in the profit rates realized were found to be a function of where the actual index numbers fell. On Contract A all of the actual index numbers were greater than the 4% upper band index numbers. Thus, when the width of the band percentage was doubled, the profit lost doubled and the reduction in the profit rate realized was slightly more than doubled.

On Contract D some of the actual index numbers were between the projected index numbers and the 4% upper band index numbers. Hence, when a 4% band was used, the profit lost and the reduction in the profit rate realized was less than double the amount of profit lost and the reduction in the profit rate realized when a 2% band was used.

Regarding the government/contractor share ratio, as the contractor's share percentage increased, the profit earned and the profit rates realized decreased. Furthermore, the profit lost was directly proportional to the increase in the contractor's share percentage.

Comparing the results obtained from varying the selected provisions revealed that not fully escalating profit usually had a greater effect on the profit earned and the profit rates realized than did the selected band/share ratio combinations. This was true for ten of the twelve comparisons made. When comparing the results obtained from varying the share percentage to the results obtained from varying the band width, it was revealed that when a 90/10 share ratio was used, increasing the contractor's share percentage to 20% caused the same or a greater reduction in the profit earned and the profit rates realized than did increasing the band percentage from 2% to 4%. However, when an 80/20 share ratio was used, increasing the width of the band percentage from 2% to 4% caused a greater reduction in the profit earned and the profit rates realized than did increasing the contractor's share percentage to 30%.

Conclusions and Recommendations

It can generally be concluded that differences in the way economic price adjustment provisions are implemented affect the profit

earned and the profit rates realized on fixed-price type contracts and that these effects can be predicted. For the contracts included in this study, the profit earned and the profit rates realized decreased when profit was not included in the dollar amount of contract price subject to adjustment and/or bands were used to share the increased costs resulting from abnormal inflation. Furthermore, when bands were used, widening the band width and/or increasing the contractor's share percentage caused additional decreases in the profit earned and the profit rates realized.

The "Profit 76" study, which is currently being conducted within the DOD, is tasked with recommending changes in DOD profit policy which will directly and favorably act to strengthen the competitive industrial base of defense industries. (Ref 29). It can be concluded from the findings presented in this study that changes could also be made regarding economic price adjustment provisions which would act to strengthen the competitive industrial base. It is recommended that consideration be given to making the following modifications: 1) include some or all of the profit in the dollar amount of contract price subject to adjustment in order to compensate for the impact of abnormal inflation on profit, 2) eliminate, or restrict to narrow percentages, the use of upper and lower bands, and 3) identify lower contractor share percentages (than those used for performance incentive purposes) for use in sharing the abnormal inflationary costs occurring within the bands. The results presented in this study should assist in determining whether changes in the economic price adjustment area should be made.

Future Studies

As previously mentioned, little research has been conducted regarding the effect of EPA clauses and provisions of these clauses on contract cost and profit. It is believed that future studies on this subject would be beneficial. Such studies would provide additional insight as to whether changes in EPA provisions should be made in order to better support DOD profit policy objectives.

APPENDIX A

QUANTITATIVE COMPUTATIONS PERFORMED ON CONTRACT A

APPENDIX A

QUANTITATIVE COMPUTATIONS PERFORMED ON CONTRACT A

I. Supporting Contract Data

TABLE A-1

Contract A Data

1) Contract Type FPI		2) Ceiling Price $165,718,180
3) Contract Price $146,030,505		4) Contract Target Cost $132,771,487
5) Profit $13,259,018	6) Going-in Profit Rate 10%	7) Share Ratio 70/30
8) Total Amt. Subj. to EPA $126,696,000		8a) Labor Amt: $75,931,000 8b) Material Amt: $50,765,000
9) BLS Indexes	9a) Labor - SIC Code 37 Base Value = $4.71 - CY 72	
	9b) Material - WPI: Industrial Commodities Base Value = 117.9 - CY 72	

	Material		Labor	
10) Adjust. Period	11) Expnd. Profile	12) Hi/Low Band (2%)	13) Expnd. Profile	14) Hi/Low Band (2%)
Base		117.9*		$4.71*
CY 75	$22,643K	130.0/125.0	$25,544K	$5.40/$5.18
CY 76	26,369K	133.9/128.7	45,510K	$5.67/$5.45
CY 77	1,753K	137.9/132.5	4,877K	$5.97/$5.73
Total	$50,765K		$75,931K	

*Notes applicable to this table are addressed on the following page. (Refs 3; 6; 33; 39).

*The base value indexes were established by averaging the monthly BLS indexes for calendar year 1972. Adjustments were not begun until 1975 because the EPA clause only pertained to production options, which were not exercised until 1974. Additionally, the projected index numbers, which are not shown on this chart, are equal to the average of the hi/low or upper/lower band index numbers. Furthermore, the projected and upper/lower band index numbers reflect predicted increases from the actual 1972 BLS index values rather than predicted increases from a base period index number of 100.

II. Adjustments to Date

$$\text{Adj. Above Upper Band (UB)} = \frac{\text{Act. Ind.(L)-UB Index(L)}}{\text{UB Index (L)}} \text{ (Expnd. Profile (L))} + \frac{\text{Act. Ind.(M)-UB Index(M)}}{\text{UB Index (M)}} \text{ (Expnd. Profile (M))} \quad (8)$$

$$\text{Adj. Below Lower Band (LB)} = \frac{\text{Act. Ind.(L)-LB Index(L)}}{\text{LB Index (L)}} \text{ (Expnd. Profile (L))} + \frac{\text{Act. Ind.(M)-LB Index(M)}}{\text{LB Index (M)}} \text{ (Expnd. Profile (M))} \quad (9)$$

The above contract formulas will be used to make the CY 75 actual adjustment. However, future adjustments will modify the above formulas by using the projected index in the denominator which is the correct formula to use with bands and projected expenditure profiles which include a normal amount of inflation. (Ref 15:67-68).

$$\text{1st Adj.} = \frac{6.02 - 5.40}{5.40} (\$25{,}544K) + \frac{171.5 - 130.0}{130.0} (\$22{,}643K) \quad (10)$$

1st Adj. = $2,932,830 + $7,228,342 = $10,161,172

III. Predicting the Actual Index for Future Adjustments

A. Establishing New Base Index Numbers

TABLE A-II

New Base Indexes

Classification	Time Period			New Base Indexes (average)
	Nov75	Dec75	Jan76	
Labor				
SIC Code 37	$6.25	$6.39	$6.35	$6.33
Material				
Industrial Commodities	175.4	176.1	177.3	176.3

(Refs 48 and 49)

B. Predicting Future Index Numbers

TABLE A-III

Prediction of Composite Contract Index

	110C Indexes (Production)			Contract Weights (Percentages)			Composite Index
FY	A/F	Eng.	Avion.	A/F	Eng.	Avion.	Contract
75	100.00	100.00	100.00	81	19	---	100.000
76	108.20	110.70	107.20	77	23	---	108.775
7t	113.10	115.60	111.80	74	26	---	113.750
77	118.30	120.90	116.60	70	30	---	119.080
78	127.30	130.40	125.10	70	30	---	128.230

(Refs 3 and 9)

C. Determining the Actual Index Numbers at the Midpoint of the Adjustment Period

TABLE A-IV

Composite Index Numbers (CIN) for Remaining Adjustments

Adj. Time Period	[1] $\frac{(B)\text{Index}}{(E)\text{Index}} = X$	[2] $\sqrt[N]{X}=Y$	[3] $(Y)^M = Z$	[4] CIN $(Z) \times (B)$ Index
2nd	1.0457	1.0060	1.0364	112.7
3rd	1.0768	1.0062	1.0187	121.3

(Ref 9)

D. Change in Index from New Base

TABLE A-V

Change in Index from New Base

Midpoint of Adj. Time Period	CIN	Cin - 1 Jan 76	$\frac{\text{CIN}}{\text{CIN 1 Jan 76}}$
1 Jul 76	112.7	108.8	1.036
1 Jul 77	121.3	108.8	1.115

E. The Predicted Actual Index

TABLE A-VI

Derivation of the Predicted Actual Index Numbers

Adj. Per.	Category	New Base Index	X	$\frac{\text{CIN}}{\text{CIN 1 Jan 76}}$	=	Pred. Act. Index
2nd	Labor	$6.33	X	1.036	=	$6.56
	Material	176.3	X	1.036	=	182.6
3rd	Labor	$6.33	X	1.115	=	$7.06
	Material	176.3	X	1.115	=	196.6

IV. Calculating the Remaining Adjustments

TABLE A-VII

Calculations of the Remaining Adjustments

Labor					Material				
Adj. Per.	Pred. Act. Ind.	UB Ind.	Expnd. Profile	Adjmt.	Pred. Act. Ind.	UB Ind.	Expnd. Profile	Adjmt	Total
1	$6.02*	$5.40	$25,544K	$ 2,932,830	171.5*	130.0	$22,643K	$ 7,228,342	$10,161,172**
2	$6.56	$5.67	$45,510K	$ 7,284,874	182.6	133.9	$26,369K	$ 9,780,429	$17,065,303
3	$7.06	$5.97	$ 4,877K	$ 908,706	196.6	137.9	$ 1,753K	$ 761,103	$ 1,669,809
				$11,126,410				$17,769,874	$28,896,284

*Actual Index Numbers.

**Actual Adjustment Value.

V. Impact on Profit Earned and the Coming-out Profit Rate

The adjustment for the abnormal inflationary costs above the band index numbers is $28,896,284 (from Table A-VII). However, the abnormal inflationary costs between the upper band index numbers and the projected index numbers must be determined before the impact on profit earned and the coming-out profit rate can be calculated. The upper band index numbers are 2% higher than the projected index numbers. Since all of the predicted actual index numbers were higher than the upper band index numbers (from Table A-VII), the dollar amount of inflationary costs within the band is 2% ((UB Index - Proj. Ind)/Proj. Index = 2%) times the amount of contract price subject to adjustment. On Contract A, this calculation yields $2,533,920 (.02 X $126,696,000). The government/contractor share ratio is 70/30. The government's share of the abnormal inflationary costs within the band is $1,773,744 (.70 X 2,533,920); the contractor's share is $760,176 (.30 X $2,533,920). The contractor's share effectively reduces the profit earned on the contract by $760,176. Profit earned equals $12,498,842 ($13,259,018 - $760,176). The coming-out profit rate is 7.65%. The derivation of the coming-out profit rate is shown below.

Profit Objective = $13,259,018
Contractor's Share of in band costs = $760,176
Target Cost = $132,771,487
Economic Price Adjustments = $28,896,284
Government's share of in band costs = $1,773,744

$$\text{Coming-out Profit rate} = \frac{\$13,259,018 - \$760,176}{\$132,771,487 + \$28,896,284 + \$1,773,744} \quad (11)$$

$$\text{Coming-out Profit rate} = \frac{\$12,498,842}{\$163,441,515} = 7.65\%$$

APPENDIX B

QUANTITATIVE COMPUTATIONS PERFORMED ON CONTRACT B

APPENDIX B

QUANTITATIVE COMPUTATIONS PERFORMED ON CONTRACT B

I. Supporting Contract Data

TABLE B-I

Contract B Data*

1) Contract Type FPI		2) Ceiling Price $34,800,000
3) Contract Price $30,340,000		4) Contract Target Cost $27,210,000
5) Profit $3,130,000	6) Going-in Profit Rate 11.5%	7) Share Ratio 80/20
8) Total Amt. Subj. to EPA $27,000,000		8a) Labor Amt: $24,280,000 8b) Material Amt: $2,720,000
9) BLS Indexes	9a) Labor SIC Code 372 Base Value = $5.71 - 1st Qtr. 1975	
	9b) Material - WPI: Industrial Commodities Base Value = 167.3 - 1st Qtr. 1975	

	Material		Labor	
10) Adjust. Period	11) Expnd. Profile	12) Base Index**	13) Expnd. Profile	14) Base Index**
Base		167.3		$5.71
CY 75	$ 120,000	167.3	$ 4,880,000	$5.71
CY 76	$1,600,000	167.3	$ 8,400,000	$5.71
CY 77	$1,000,000	167.3	$ 9,000,000	$5.71
CY 78	---	---	$ 2,000,000	$5.71
Total	$2,720,000		$24,280,000	

*Contract B uses the contant dollar method of adjustment. Thus, dollar amounts shown in this chart were priced in first quarter 1975 dollars.

**Base index numbers are used in the adjustment formula when the constant dollar method of adjustment is used. (Refs 1; 4; 31; 40).

In accordance with contract provisions, the average of the actual BLS indexes for the months identified below will be used in the adjustment formula. (Ref 40).

Adj. Period	Months to Determine Actual Index
1st Adj. CY 75	Aug, Sept, Oct, 1975
2nd Adj. CY 76	May, June, July 1976
3rd Adj. CY 77	May, June, July 1977
4th Adj. CY 78	Jan, Feb, Mar, 1978

II. Adjustments to Date

$$\text{Adj.} = \left[\frac{\text{Act. Ind.(L)} - \text{Base Ind.(L)}}{\text{Base Index (L)}}(\text{Expenditure Profile(L)}) + \frac{\text{Act. Ind.(M)} - \text{Base Ind.(M)}}{\text{Base Index (M)}}(\text{Expenditure Profile(M)}\right](1.085) \quad (12)$$

Labor - SIC Code 372: Aug. - \$6.05, Sept. - \$6.11, Oct. - \$6.16

Average = \$6.11

Material - Indust. Comm.: Aug. - 172.2, Sept. - 173.1, Oct - 174.7

Average = 173.3

$$\text{1st Adj.} = \left[\frac{\$6.11 - \$5.71}{\$5.71}(\$4{,}880\text{K}) + \frac{173.3 - 167.3}{167.3}(\$120\text{K})\right](1.085) \quad (13)$$

1st Adj. = (\$341,856 + \$4,304) X 1.085

1st Adj. = (\$346,160) X 1.085

1st Adj. = \$375,583

III. Predicting the Actual Index for Future Adjustments

A. Establishing New Base Index Numbers

TABLE B-II

New Base Indexes

Classification	Time Period			New Base Indexes (average)
	Nov75	Dec75	Jan76	
Labor				
SIC Code 372	$6.23	$6.31	$6.27	$6.27
Material				
Industrial Commodities	175.4	176.1	177.3	176.3

(Refs 48 and 49)

B. Predicting Future Index Numbers

TABLE B-III

Prediction of Composite Contract Index

	110 C Indexes Development			Contract Weights (Percentages)			Composite Index
FY	A/F	Eng.	Avion.	A/F	Eng.	Avion.	Contract
75	100.0	100.0	100.0	18	7	75	100.000
76	108.1	110.0	106.9	18	7	75	107.333
7t	112.9	114.7	111.5	18	7	75	111.976
77	118.1	119.8	116.4	18	7	75	116.944
78	127.1	129.0	124.9	18	7	75	125.583

(Refs 1 and 9)

C. Determining the Actual Index Numbers at the Midpoint of the Adjustment Period

TABLE B-IV

Composite Index Numbers (CIN) for Remaining Adjustments

Adj. Time Period	$\frac{\text{(B) Index}}{\text{(E) Index}} = X$	$\sqrt[N]{X=Y}$	$(Y)^M = Z$	CIN (Z) X (B) Index
2nd	1.043	1.0057	1.0345	111.0
3rd	1.074	1.0059	1.0179	119.0
4th	1.074	1.0059	1.0675	124.8

(Ref 9)

D. Change in Index from New Base

TABLE B-V

Change in Index from New Base

Midpoint of Adj. Time Period	CIN	CIN 1 Jan 76	$\frac{\text{CIN}}{\text{CIN 1 Jan 76}}$
15 June 76	110.0	107.3	1.034
15 June 76	119.0	107.3	1.109
15 Feb. 78	124.8	107.3	1.163

E. The Predicted Actual Index

TABLE B-VI

Derivation of the Predicted Actual Index Numbers

Adj. Per.	Category	New Base Index	X	CIN / CIN 1 Jan 76	=	Pred. Actual Index
2nd	Labor	$6.27	X	1.034	=	$6.48
	Material	176.3	X	1.034	=	182.3
3rd	Labor	$6.27	X	1.109	=	$6.95
	Material	176.3	X	1.109	=	195.5
4th	Labor	$6.27	X	1.163	=	$7.29
	Material	176.3	X	1.163	=	205.0

IV. Calculating the Remaining Adjustments

TABLE B-VII

Calculations of the Remaining Adjustments

Labor					Material				
Adj. Per.	Pred. Act. Ind.	Base Ind.	Expnd. Profile	Adjmt.	Pred. Act. Ind.	Base Ind.	Expnd. Profile	Adjmt.	Total*
1**	$6.11	$5.71	$4,880K	$ 341,856	173.3	167.3	$ 120K	$ 4,304	$ 375,583
2	$6.48	$5.71	$8,400K	$1,132,749	182.3	167.3	$1,600K	$143,455	$1,384,681
3	$6.95	$5.71	$9,000K	$1,954,466	195.5	167.3	$1,000K	$168,559	$2,303,482
4	$7.29	$5.71	$2,000K	$ 553,415				$316,318	$ 600,455
				$3,982,486					$4,664,201

*The total dollar amount in the total column is 8.5% higher than the summation of the labor and material adjustment dollar amounts. The total column includes the adjustment for profit.

**The first adjustment shows actual index numbers and the actual adjustment dollar value.

V. Impact on Profit Earned and the Coming-out Profit Rate

Profit Objective = $3,130,000

Adjustment for Profit = $365,397

Target Cost = $27,210,000

Adjustment for Cost = $4,298,804

$$\text{Profit Earned} = \$3,130,000 + \$365,397 = \$3,495,397 \quad (14)$$

$$\text{Coming-out Profit Rate} = \frac{\$3,130,000 + \$365,397}{\$27,210,000 + \$4,298,804}$$

$$\text{Coming-out Profit Rate} = \frac{\$3,495,397}{\$31,508,804} = 11.09\% \quad (15)$$

APPENDIX C

QUANTITATIVE COMPUTATIONS PERFORMED ON CONTRACT C

APPENDIX C

QUANTITATIVE COMPUTATIONS PERFORMED ON CONTRACT C

I. Supporting Contract Data

TABLE C-I

Contract C Data*

1) Contract Type: FFP		2) Ceiling Price: N/A
3) Contract Price: $93,557,000		4) Contract Cost: $84,285,586
5) Profit: $9,271,414	6) Going-in Profit Rate: 11%	7) Share Ratio: N/A
8) Total Amt. Subj. to EPA: $84,000,000		8a) Labor Amt: $52,500,000 8b) Material Amt: $31,500,000
10) BLS Indexes	9a) Labor SIC Code 372 Base Value = $5.25 - 1st Quarter 1974	
	9b) Material - WPI: Industrial Commodities Base Value = 138.6 - 1st Quarter 1974	

	Material		Labor	
10) Adjust. Period	11) Expnd. Profile	12) Base Index**	13) Expnd. Profile	14) Base Index**
Base		138.6		$5.25
1Apr74-30Jun75	$14,700K	138.6	$10,500K	$5.25
1Jul75-31Dec75	$ 8,400K	138.6	$12,600K	$5.25
1Jan76-30Jun76	$ 6,300K	138.6	$18,900K	$5.25
1Jul76-28Feb77	$ 2,100K	138.6	$10,500K	$5.25
Total	$31,500K		$52,500K	

*Contract C uses the constant dollar method of adjustment. Thus, dollar amounts shown in this chart were priced in 1st quarter 1974 dollars.

**Base Indexes are used in the adjustment formula when the constant dollar method of adjustment is used. (Refs 1; 26; 31; 41).

In accordance with contract provisions, the average of the actual BLS indexes for the months identified below will be used in the adjustment formula. (Ref 41).

Adjustment Period		Months to Determine Actual Index
1st Adj.	1Apr74 - 30Jun75	Feb, Mar, Apr, 1975
2nd Adj.	1Jul75 - 31Dec75	Sept, Oct, Nov, 1975
3rd Adj.	1Jan76 - 30Jun76	Feb, Mar, Apr, 1976
4th Adj.	1Jul76 - 28Feb77	Aug, Sept, Oct, 1976

II. Adjustments to Date

$$\text{Adj.} = \frac{\text{Act. Index(L)} - \text{Base Index (L)}}{\text{Base Index(L)}} \text{ (Expend. Profile(L))} +$$

$$\frac{\text{Act. Index(M)} - \text{Base Index(M)}}{\text{Base Index(M)}} \text{ (Expend. Profile(M))} \qquad (16)$$

Labor - SIC 372: Feb. - \$5.71, Mar. - \$5.75, Apr. - \$5.79

Average = \$5.75

Material - Indus. Comm.: Feb. - 168.4, Mar. - 168.9, Apr. - 169.7

Average = 169.0

$$\text{1st Adj.} = \frac{\$5.75 - \$5.25}{\$5.25} (\$10.5\text{M}) + \frac{169.0 - 138.6}{138.6} (\$14.7\text{M}) \qquad (17)$$

$$= \$1{,}000{,}000 + \$3{,}224{,}242 = \$4{,}224{,}242$$

Labor - SIC 372: Sep. - $6.11, Oct. - $6.16, Nov. - $6.23

Average = 6.17

Material - Indus. Comm.: Sep. - 173.1, Oct. - 174.7, Nov, - 175.4

Average = 174.4

$$\text{2nd Adj.} = \frac{\$6.17 - \$5.25}{\$5.25} (\$12.6M) + \frac{174.4 - 138.6}{138.6} (\$8.4M) \qquad (18)$$

$$= \$2,208,000 + \$2,169,697 = \$4,377,697$$

III. Predicting the Actual Index for Future Adjustments

A. Establishing New Base Index Numbers

TABLE C-II

New Base Indexes

Classification	Time Period			New Base Indexes (average)
	Nov75	Dec75	Jan76	
Labor				
SIC Code 372	$6.23	$6.31	$6.27	$6.27
Material				
Industrial Commodities	175.4	176.1	177.3	176.3

(Refs 48 and 49)

B. Predicting Future Index Numbers

TABLE C-III

Prediction of Composite Contract Index

	110 C Indexes Production			Contract Weights (Percentages)			Composite Index
FY	A/F	Eng.	Avion.	A/F	Eng.	Avion.	Contract
75	100.0	100.0	100.0	60	7	33	100.000
76	108.2	110.7	107.2	60	7	33	108.045
7t	113.1	115.6	111.8	60	7	33	112.846
77	118.3	120.9	116.6	60	7	33	117.921

(Refs 1 and 9)

C. Determining the Actual Index Numbers at the Midpoint of the Adjustment Period

TABLE C-IV

Composite Index Numbers (CIN) for Remining Adjustments

Adj. Time Period	$\frac{\text{(B) Index}}{\text{(E) Index}} = X$	$\sqrt[N]{X=Y}$	$(Y)^M = Z$	CIN (Z) X (B) Index
3rd	1.044	1.0058	1.0175	109.9
4th	1.044	1.0058	1.0088	113.8

(Ref 9)

D. Change in Index from New Base

TABLE C-V

Change in Index from New Base

Midpoint of Adj. Time Period	CIN	CIN 1 Jan 76	$\frac{\text{CIN}}{\text{CIN 1 Jan 76}}$
15 Mar 76	109.9	108.0	1.018
15 Sep 76	113.8	108.0	1.054

E. The Predicted Actual Index

TABLE C-VI

Derivation of the Predicted Actual Index Numbers

Adj. Per.	Category	New Base Index	X	$\frac{\text{CIN}}{\text{CIN 1 Jan 76}}$	=	Pred. Actual Index
3rd	Labor	$6.27	X	1.018	=	$6.38
	Material	176.3	X	1.018	=	179.5
4th	Labor	$6.27	X	1.054	=	$6.61
	Material	176.3	X	1.054	=	185.8

IV. Calculating the Remaining Adjustments

TABLE C-VII

Calculations of the Remaining Adjustments

Labor					Material				
Adj. Per.	Pred. Act. Ind.	Base Ind.	Expnd. Profile	Adjmt.	Pred. Act. Ind.	Base Index	Expnd. Profile	Adjmt.	Total
1*	$5.75	$5.25	$10,500K	$1,000,000	169.0	138.6	$14,700K	$3,224,242	$ 4,224,242
2*	$6.17	$5.25	$12,600K	$2,208,000	174.4	138.6	$ 8,400K	$2,169,697	$ 4,377,697
3	$6.38	$5.25	$18,900K	$4,068,000	179.5	138.6	$ 6,300K	$1,859,090	$ 5,927,090
4	$6.61	$5.25	$10,500K	$2,720,000	185.8	138.6	$ 2,100K	$ 715,151	$ 3,435,151
				$9,996,000				$7,968,180	$17,964,180

*First and second adjustments show actual index numbers and the actual adjustment dollar values.

V. Impact on Profit Earned and the Coming-out Profit Rate

Four million dollars of the $84M subject to economic price adjustment was for profit. Therefore, 4.762% ($4M/$84M) of the total adjustment dollar amount of $17,964,180 was for profit ($855,437).

Profit Objective = $9,271,414

Adjustment for Profit = $855,437

Contract Cost Objective = $84,285,586

Adjustement for Cost = $17,108,743

$$\text{Profit Earned} = \$9,271,414 + \$855,437 = \$10,126,851 \quad (19)$$

$$\text{Coming-out Profit Rate} = \frac{\$\ 9,271,414 + \$\ 855,437}{\$84,285,586 + \$17,108,743} \quad (20)$$

$$\text{Coming-out Profit Rate} = \frac{\$\ 10,126,851}{\$101,367,329} = 9.99\%$$

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Economic price adjustment (EPA) clauses are currently being used on Department of Defense major weapon system fixed-price type contracts to protect the contractor and the government against significant economic fluctuations in contract prices. The Armed Services Procurement Regulations provide "general guidelines" regarding the use of EPA clauses. Thus, there are many varieties of EPA clauses. They differ in the manner in which certain EPA provisions are implemented and in the methods of adjustment utilized. Little research has been conducted regarding how EPA clauses are actually

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being implemented and what effect these clauses have on contract cost and profit.

In this study quantitative computations were performed in order to predict the effect of EPA clauses currently in use on four fixed-price type contracts on the profit earned and the profit rates realized on these contracts. Also, the effect of varying selected provisions of the contractual EPA clauses on the profit earned and the profit rates realized on the contracts was determined. The results presented in this study should assist in determining whether changes in EPA provisions should be made in order to better support Department of Defense profit policy objectives.